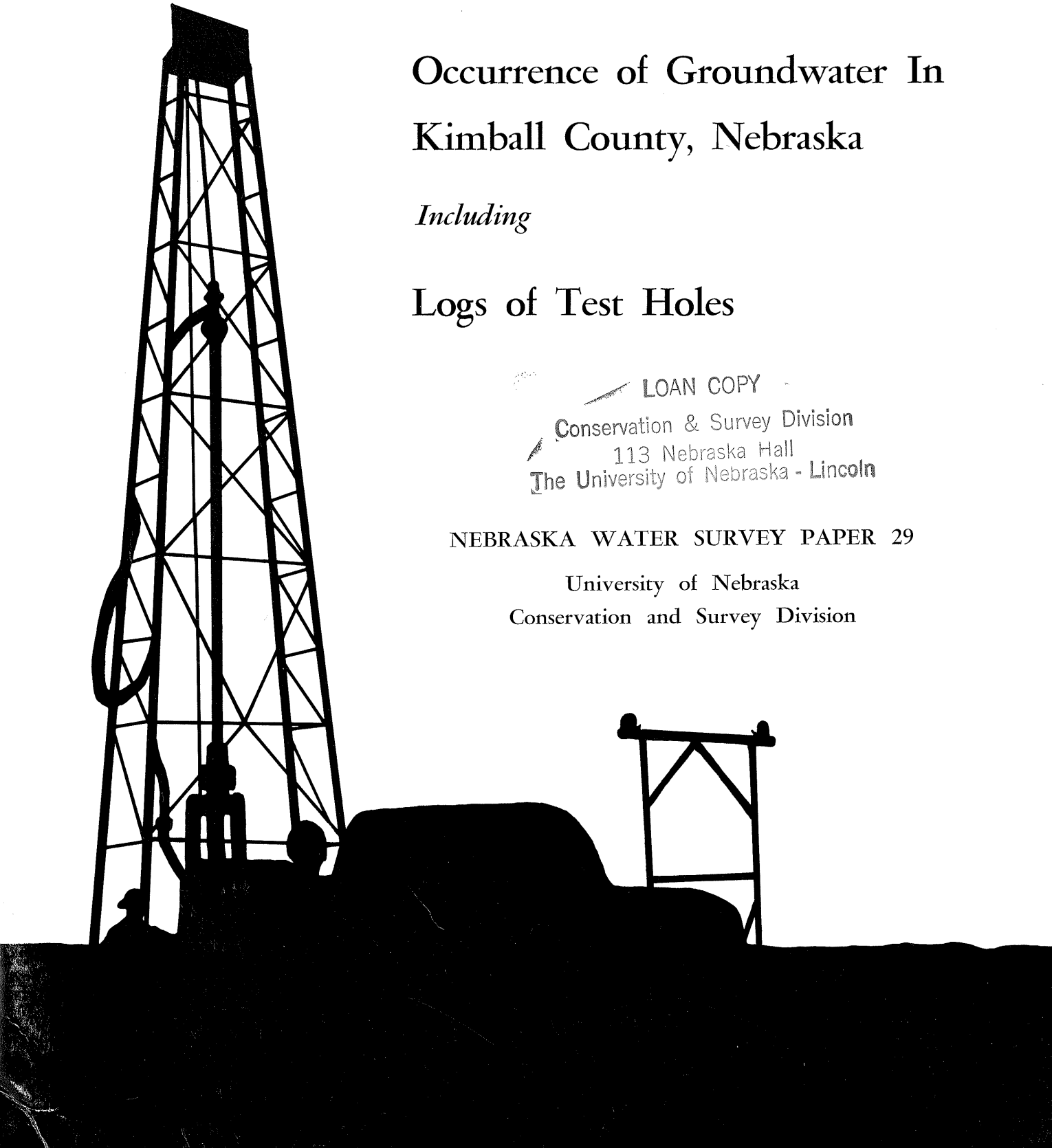
6-1971

Occurrence of Groundwater in Kimball County, Nebraska: Including Logs of Test Holes

Frank A. Smith
University of Nebraska - Lincoln

Vernon L. Souders
University of Nebraska - Lincoln



Occurrence of Groundwater In Kimball County, Nebraska

Including

Logs of Test Holes

LOAN COPY
Conservation & Survey Division
113 Nebraska Hall
The University of Nebraska - Lincoln

NEBRASKA WATER SURVEY PAPER 29

University of Nebraska
Conservation and Survey Division

NEBRASKA WATER SURVEY PAPER

NUMBER 29 JUNE 1971

OCCURRENCE OF GROUNDWATER IN KIMBALL COUNTY, NEBRASKA

Including

LOGS OF TEST HOLES

By

FRANK A. SMITH AND VERNON L. SOUDERS
Hydrogeologists, Conservation and Survey Division

Prepared in cooperation with the
American National Bank, Kimball, Nebraska

PUBLISHED BY THE UNIVERSITY OF NEBRASKA
CONSERVATION AND SURVEY DIVISION, LINCOLN

The Conservation and Survey Division of the University is the agency designated by statute to investigate and interpret the geologically related resources of the state, to make available to the public the results of these investigations, and to assist in the development and conservation of these resources.

The Division is authorized to enter into agreements with federal agencies to engage in cooperative surveys and investigations in the state. Publications of the Division and the cooperating agencies are available from the Conservation and Survey Division, University of Nebraska, Lincoln 68508.

Publications and price lists are furnished upon request.

CONTENTS

ILLUSTRATIONS

OCCURRENCE OF GROUNDWATER IN KIMBALL COUNTY, NEBRASKA
Including
LOGS OF TEST HOLES

By

Frank A. Smith and Vernon L. Souders

INTRODUCTION

This water-survey paper reports the results of two test-drilling programs designed to explore the availability of groundwater in Kimball County. Thirty-eight test holes were drilled in the summer of 1969 as part of a continuing statewide test-drilling program conducted by the Conservation and Survey Division of the University of Nebraska in cooperation with the Water Resources Division of the U. S. Geological Survey. In an effort to stimulate the development of water resources in the county, the American National Bank of Kimball contracted with Mr. Ed Killham of Potter, Nebraska to drill 14 additional test holes in the fall of 1970. Frank Smith supervised the drilling and logging for both programs. The objectives of the investigation were to determine the availability of groundwater and to map and describe the rocks in which it occurs. The test-hole information is also useful in an evaluation of soils, construction materials, oil and gas potential, and other geologic resources and their uses.

This report includes logs of all the test holes drilled. Interpretation of information derived from the test drilling is presented on three maps and two geologic sections. These interpretations may be modified or expanded as more information is obtained.

Kimball County lies in the southwest corner of the Nebraska Panhandle (figure 1) and is part of the Great Plains of the United States. The soil survey report for Kimball County describes the soils, topography, drainage, and climate of the county. U. S. Geological Survey Paper 1410 describes the water resources of Lodgepole Creek valley. These reports and others that contain information pertinent to the groundwater resources of Kimball County and two adjoining counties are:

Soil Survey of Kimball County, Nebraska, by Richard K. Jackson, 1962: U. S. Dept. of Agriculture, Series 1957, No. 14.

Geology and ground-water resources of the Lower Lodgepole Creek Drainage Basin, Nebraska, by L. S. Bjorklund, 1957: U. S. Geological Survey, Water-Supply Paper 1410.

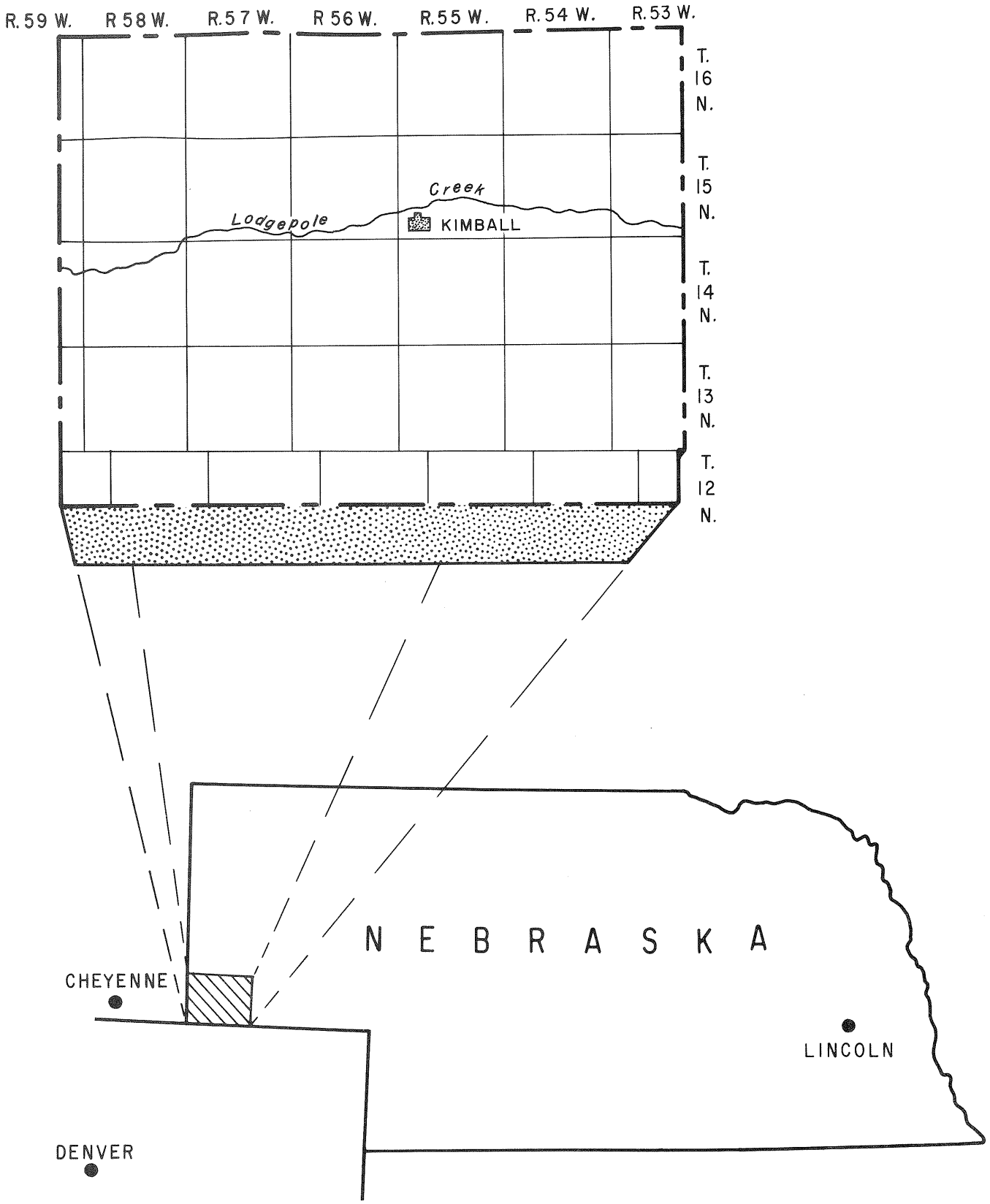


Figure 1 Map showing location of Kimball County

Geology and ground-water resources of Laramie County, Wyoming, by Marlin E. Lowry and Marvin A. Crist, 1967: U. S. Geological Survey, Water-Supply Paper 1834.

Availability of groundwater for irrigation in Cheyenne County, Nebraska, by Frank A. Smith, 1959: University of Nebraska, Conservation and Survey Division, in cooperation with Wheat Belt Public Power District and local interests.

Subsurface relations of the Cretaceous and Tertiary in western Nebraska, by Harold M. DeGraw, 1969: University of Nebraska, Lincoln, unpublished M.Sc. thesis.

PERSONNEL AND ACKNOWLEDGMENTS

The test-drilling crew during the summer of 1969 consisted of drill-machine operator Eugene Debus and helpers Dennis Aandahl, Harley Carr, and Theodore Becker. Frank Smith and Harold DeGraw were the principal geologists. Smith also served as geologist for the drilling done in the fall of 1970, and he determined altitudes of most of the test holes with an altimeter. Mr. Stanley Juelfs of the American National Bank at Kimball made local arrangements and helped in other ways to expedite the investigation.

TEST-DRILLING PROCEDURES

Test holes were drilled with hydraulic rotary rigs. Cuttings were collected continuously during drilling. Representative cuttings from every five-foot interval or from every change in material, whichever was less, were placed in porous bags and labelled with the test hole number, legal description, and depth. During the drilling geologists described the texture, color, calcareous content, and other notable features of each of these samples. The drilling action which occurred during each sampled interval was noted, and the drilling time required for each five-foot interval recorded. At the completion of drilling an electric log was made of every hole that remained open, by lowering a single-point electrode to the bottom of the hole. The resulting graphs of the electrical properties of subsurface materials were used to assist in sample-log analysis. Depths to water in the test holes that remained open were measured several days after the completion of the hole and after fluid in the drill hole had stabilized. The holes were then plugged.

TEST-HOLE NUMBERING SYSTEM

Each of the test holes has been assigned two identification numbers. One is a location number based on the land subdivisions within the U. S. Bureau of Land Management's survey of Nebraska. This system of numbering is illustrated in figure 2. The numeral preceding N in the location number indicates the township, the number preceding W indicates the range; and the number preceding the lowercase letters indicates the section. The lowercase letters denote, respectively, the quarter section, the quarter-quarter section, and the quarter-quarter-quarter section, and are assigned in counterclockwise direction beginning with the northeast subdivision. The other number is a field number which consists of three segments, the first of which is a sequential number and the last the year drilled. The middle segment of the field number for holes drilled in 1969 designates the drill machine used and the middle segment of field numbers for holes drilled in 1970 are the initials of the American National Bank.

GEOLOGY AND THE OCCURRENCE OF GROUNDWATER IN KIMBALL COUNTY

Groundwater is the water that fills the spaces between sand, gravel, silt, and clay particles and occupies the cracks, crevices, or other openings in rock units. Groundwater stored in sandstone, sand and gravel beds, or in rock units which have abundant cracks or other openings can be pumped from a well because the spaces are interconnected and large enough to permit the movement of water to the well. In materials such as silt, clay, or well-cemented sandstone the spaces are too small to allow the water to move readily to a well, so little or no water is available from these materials.

The various earth materials underlying Kimball County can be divided into formations or groups of formations. Each formation or group of formations has a set of characteristics which allows it to be identified and which affect the availability of water. Formations related to the groundwater supplies of Kimball County are the Pierre, Lance, and Fox Hills Formations of Cretaceous age; the Chadron and Brule Formations; the formations of the Arikaree Group; the Ogallala Formation of Tertiary age; and unconsolidated deposits (a set of formations) of Quaternary age. The classification of these units is shown in the following table:

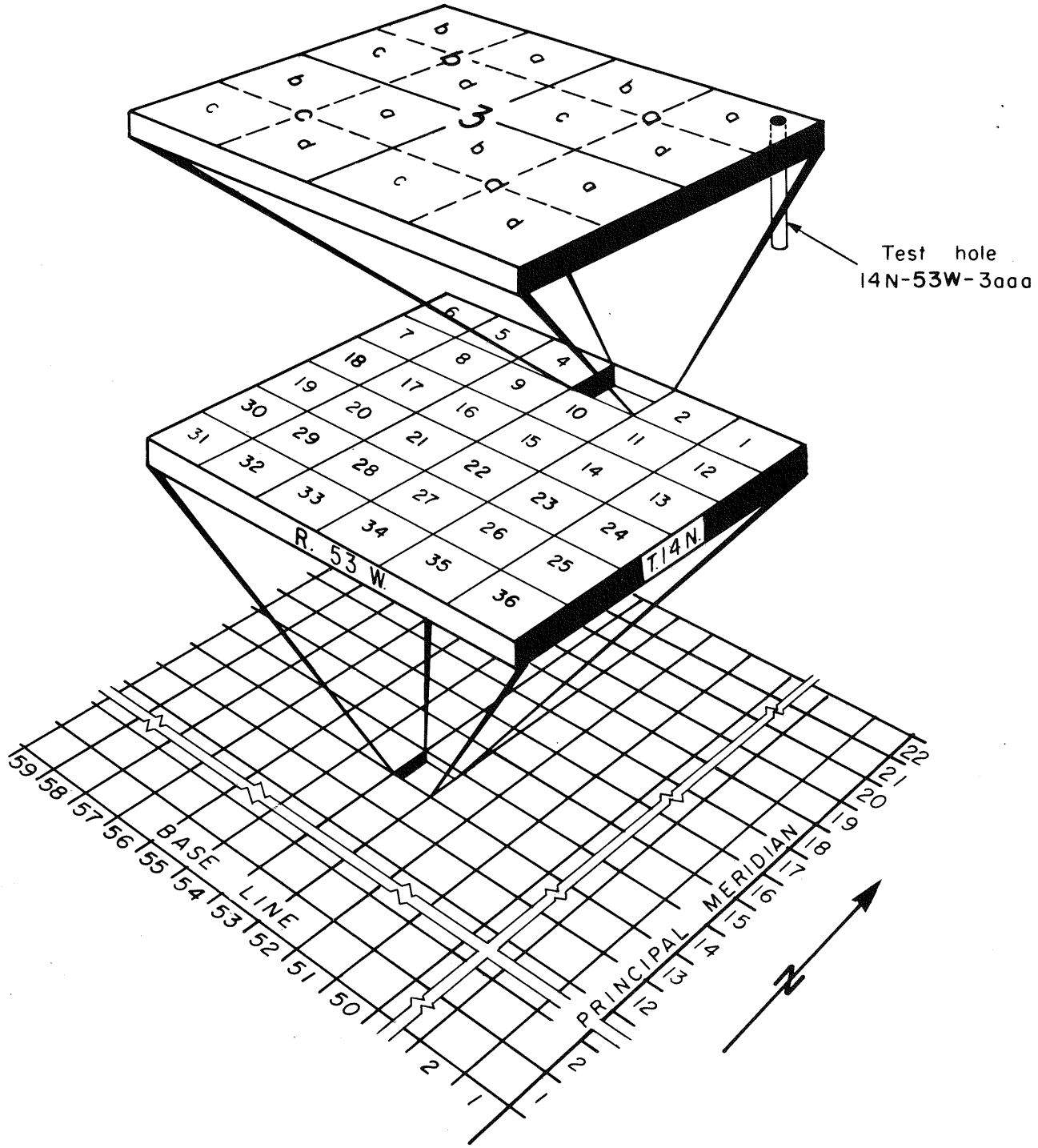


Figure 2—Well-numbering system

SYSTEM	SERIES	GROUP	FORMATION
QUATERNARY	HOLOCENE	(UNDIFFERENTIATED	
	PLEISTOCENE		
TERTIARY	PLIOCENE	-----	OGALLALA
	MIOCENE	ARIKAREE	(UNDIFFERENTIATED)
	OLIGOCENE	WHITE RIVER	BRULE
			CHADRON
CRETACEOUS	UPPER CRETACEOUS	MONTANA	LANCE
			FOX HILLS
			PIERRE

The general relationship of these geologic units to one another is illustrated by the geologic sections of plate 1. The sections are based on information from the test-drilling programs and from oil and gas tests. Parts of all of the formations are capable of yielding some water to wells at some places in the county, but the Ogallala Formation is the principal unit from which quantities of water suitable for irrigation can be developed, especially beneath the uplands. (See plate 4 for estimate of potential yields from wells.) The two test-drilling programs were primarily designed to investigate this formation and the underlying Arikaree Group where it occurs. The other formations and their water-bearing characteristics are also described because in some places they can provide a source of water for a variety of needs.

Pierre Formation: The Pierre underlies the entire county at depths from about 500 feet to more than 900 feet. The test-drilling operations did not reach this formation, but information from oil and gas tests and reports from other areas indicate it consists of light- to dark-gray clay shale, silt, sandy silt, and some thin, fine sand beds. The fine-grained texture of the sediments and the excessive depth of the formation preclude the Pierre from serious consideration as a source of water for large-yield wells. Two wells each yielding 25 gallons per minute or less do pump water from the Pierre for the secondary recovery of oil in the southeastern part of the county.

Lance and Fox Hills Formations: A study of the oil and gas tests in western Nebraska by Harold M. DeGraw showed that the Lance and Fox Hills Formations overlie the Pierre in the western half of Kimball County. The depth to the top of these formations probably ranges from about 300 feet to more than 800 feet in the area where they occur. None of the test holes drilled in 1969 or 1970 penetrated these formations.

Electric logs of test wells drilled for oil and gas indicate that the Lance Formation is composed principally of interbedded sandstone and shale. The electric logs indicate that the underlying Fox Hills Formation contains more sandstone than the Lance. Both formations have a potential for yielding water in sufficient quantities for stock and domestic wells.

The quality of water in the Lance and Fox Hills is not well known. One detailed chemical analysis of water from the Lance Formation is available. The sample was taken from a domestic well that is 700 feet deep and is located just across the state line in Wyoming (sec. 35, T. 14 N., R. 60 W). The analysis shows the water contains 390 milligrams of dissolved solids per liter, and that the principal constituents are sodium, bicarbonate, and sulfate ions.

A similar analysis is also available for water from the Fox Hills Formation. This water is used for the secondary recovery of oil and is pumped from a well 751 feet deep located in section 20, T. 13 N., R. 57 W. Total dissolved solids were 366 milligrams per liter, and the principal constituents were sodium and bicarbonate ions. Traces of selenium, a substance toxic to both men and animals, were detected in the water of both samples but not in quantities sufficient to prohibit the use of the water.

Chadron Formation: The geologic sections of plate 1 show that the Chadron Formation overlies the Lance and Fox Hills Formations in western Kimball County and the Pierre Formation in the eastern part of the county. In Kimball County the Chadron usually consists of beds of greenish-gray and very light-brown clay and silt. It underlies the entire county except possibly in small areas in Township 16 North, Ranges 55 and 56 West. Electric logs of oil and gas test wells indicate that beds of sand and sandstone occur at the base of the Chadron in parts of Kimball County. Information from the North Platte valley and from Deuel County suggests that the quality of water in these sand and sandstone beds is not as good as that in shallower water-bearing horizons, and it is probably not as good as that in the Lance and Fox Hills Formations. The Chadron Formation is not considered a favorable formation for stock, domestic, or irrigation water supplies in Kimball County. Two test holes probably reached the Chadron Formation along the Banner-Kimball County line in Ranges 56 and 57 West, and one test hole southeast of Dix was drilled into material that is probably Chadron.

Brule Formation: Brown clayey silt and siltstone of the Brule Formation overlie the Chadron Formation in most of Kimball County. In small areas in Townships 15 and 16 North, Ranges 56 and 57 West, and southeast of Dix, the logs of oil and gas tests indicate that both the Brule and Chadron Formations have been entirely eroded and that formations younger than Brule rest on Cretaceous rocks.

The Brule Formation is exposed at the surface along the south side of Lodgepole Creek valley from about five miles southwest of Bushnell to the state line. In the remainder of the county it is covered by younger formations that range in thickness from a few feet in the Lodgepole Creek valley west of Bushnell to more than 600 feet in places in the northern part of the county.

Despite the fine-grained texture of its sediments, the Brule Formation yields water to several irrigation wells in Lodgepole Creek valley because a system of small to large openings in the formation serves to store and transmit water. Wells drilled into or through large openings generally have moderately large to large yields, at least early in the irrigation season. Large yields generally do not last throughout the season because the quantity of water stored in the openings is relatively small. In places where the Brule is overlain by water-saturated sediments, openings in the Brule can be kept filled by seepage from those sediments and large yields from wells can be maintained throughout the irrigation period. It is not known whether the openings in the Brule are restricted to the valley or are more widely distributed in the county. Some beds of very fine sand do occur in places within the formation, and these may be a possible source of small amounts of water.

Water from wells pumping from the openings of the Brule is quite suitable for domestic, stock, and irrigation uses. Total dissolved solids probably range from 300 to 700 milligrams per liter, with most of the water containing less than 500 milligrams per liter. The principal constituents are silica and calcium and bicarbonate ions, and the water is very hard.

Arikaree Group: The Arikaree Group overlies the Brule and older formations in parts of Townships 15 and 16 North and Ranges 56 and 57 West, and may occur at other localities in the county. The distribution and thickness of the Arikaree Group beneath Kimball County are poorly known, and it is often difficult to identify in test holes. Geologic section A-A' of plate 1 shows the position of the Arikaree Group in relation to other formations in Kimball County. The Arikaree Group is a source of groundwater for large-yield wells in the north-central part of the Nebraska Panhandle around Alliance, but the test drilling indicated that the Arikaree in Kimball County was composed of sandy silt and silty sand, often lime-cemented, and constituted a poor source of supply for large-yield wells.

Ogallala Formation: The Ogallala Formation occurs throughout the county except in the Lodgepole Creek valley from southwest of Bushnell to the state line. Parts of the formation are exposed at the surface in many places along the remainder of Lodgepole Creek valley. Elsewhere it is exposed in gullies, road cuts, and other excavations and occasionally forms the land surface.

The formation consists of alternating layers of clay, silt, sandstone, and sand and gravel. Some of these layers may be totally lacking in cementing material and some may be loosely to tightly cemented with calcium carbonate or silica. The beds of sandstone and sand and gravel, where they are filled with water and are not tightly cemented, are the most promising sources of groundwater in Kimball County. Individual sand and gravel beds, with only minor amounts of silt, may be as much as 70 feet thick, as in Test Hole 25-B-69 in section 1, Township 16 North, Range 55 West.

The average thickness of the Ogallala Formation in the 52 test holes was 265 feet. The thickness ranged from 0 feet, in the Lodgepole Creek valley, to more than 600 feet in one test hole. Ogallala thicknesses of more than 400 feet were drilled in six test holes, and all of these were within three miles of the northern border of the county.

Less than half the total volume of the Ogallala sediments contains water available to wells, and in some places the entire thickness of the formation is dry. Geologic section B-B' on plate 1 illustrates this situation. In most places south of Township 14 North along this section the water table, or the approximate upper limit of the water-filled sediments, coincides with or is below the top of the Brule Formation. This condition prevails throughout much of the southern part of the county and in small areas in the northern part. Generally, the Brule is more deeply eroded in the northern part of the county and it is here that the Ogallala and the Arikaree sediments tend to be the thickest. Large-yield wells can be developed from water contained in the sand, gravel, and sandstone that fill the "sags" and valleys eroded into the Brule or underlying rocks.

Pleistocene and Holocene (undifferentiated): The Ogallala Formation throughout most of Kimball County is covered by thin deposits of loess (wind-deposited silt) on the uplands and higher slopes, by materials which have washed down from higher elevations on the side slopes, and by water-laid sediments in the larger valleys. The water-laid sediments are silt, clay, sand, and gravel.

In the Lodgepole Creek valley, beds of sand and gravel of Pleistocene age contain water and are often thick enough to yield significant quantities to irrigation wells. Chemically, this water is similar to that in the Ogallala and Brule Formations.

Sand and gravel deposits of Pleistocene age also occur in other large drainageways of the county, but these are usually dry. Where they occur at the land surface, these deposits allow rainfall and runoff from storms to percolate underground and recharge the groundwater supply.

AVAILABILITY OF WATER TO LARGE-YIELD WELLS

The top of the Brule Formation, or older formations if the Brule is absent, generally is regarded as the base of the water-bearing sediments capable of supplying water to large-yield wells. All the test holes except one were drilled from 8 to 102 feet into the Brule or older formations to determine the thickness of sediments which might be capable of supplying large amounts of water to wells and also to map the configuration of the top of the Brule or older formations. This map is shown on plate 2 and along with the geologic sections, indicates that the top of the Brule is a surface that was eroded into "hills" and "valleys" prior to deposition of younger sediments.

The search for water beneath the uplands in Kimball County is largely a search for these buried ancient "valleys" eroded into or through the Brule Formation. Water-bearing sediments younger than the Brule are thicker in these "valleys" and they are more likely to contain stored groundwater. Geologic section B-B' clearly shows this relationship between buried valleys, thick younger deposits and stored groundwater.

The contour lines of the map on plate 2 connect points of equal altitude of the top of the Brule Formation or older formations as best as can be determined from the test drilling. The contour lines indicate a Brule "table" or "plateau" occupies most of the southwest part of Kimball County south of Lodgepole Creek and an area along the Wyoming border north of the Lodgepole. East of Range 58 West, a broad "valley" trends west to east through the central part of the county along and just north of Lodgepole Creek. A low "ridge" of Brule separates this "valley" from one that runs approximately west to east across the northern border of the county. The Brule in the southeastern part of the county is eroded into a series of "ridges" and "valleys."

Because so much of the Ogallala Formation is dry, knowledge of the shape of the water table is necessary in order to predict possible areas for developing large-yield wells. Plate 3 is a map showing the configuration of the water table as determined from water levels in test holes. The contour lines connect points of equal altitude of the water table above mean sea level. These lines show that the water table, while not a smooth, flat surface, is much more uniform and regular than either the present topography or the base of the water-bearing sediments.

The slight irregularities in the water table are due to several factors, some of which are: irregularities in the land surface, irregularities in the top of the Brule Formation, texture of the Ogallala sediments, incision of Lodgepole Creek valley into the Brule Formation in the western part of the county, and availability of recharge water following storms beneath dry draws, such as Rocky Hollow in the northeastern part of the county.

Plates 2 and 3 can be used for estimating how many feet of the Ogallala Formation, or the Ogallala Formation plus the Arikaree Group of formations, is filled with water at a particular location. This thickness is determined by subtracting the altitude of the top of the Brule or older formations from the altitude of the water table.

The thickness and texture of water-bearing formations determine the availability of water to wells. The thickness can be estimated from plates 2 and 3, but the texture must be interpreted from the test-hole records and projected to areas of interest. Plate 4 shows the interpretation of thickness and texture of the water-bearing formations with respect to potential well yields. Estimates of well yields were made at each test-hole site and plotted on a map showing the contoured thickness of the water-bearing formations and the yields of registered irrigation wells. Using the thickness contours as guidelines, areas of various potential well yields were drawn to incorporate the test-hole and irrigation-well information.

Plate 4 indicates there are four relatively small areas in Kimball County where more than 1,000 gallons of water per minute can probably be pumped from the Ogallala Formation. These areas are in the old "valleys" eroded into or through the Brule Formation along the northern border of the county and just north of Lodgepole Creek. Well yields from 500 to 1,000 gallons per minute can probably be developed over a much larger area associated with these old "valleys." The map indicates that well yields of more than 500 gallons per minute can possibly be developed in about one-quarter of the county. Well yields of 200 to 500 gallons per minute can probably be developed along the sides of these old "valleys" and in other places where the water table is far enough above the base of the Ogallala Formation. Yields in this range may be available over 15 to 20 percent of the county. Wells yielding only a very few gallons per minute up to 200 gallons per minute are probably available in some areas over about one-third of the county. Probably little or no water is available to wells from the Ogallala Formation in scattered areas which account for more than 20 percent of the county. Most of these areas are where the water table is generally below the Ogallala Formation south of Lodgepole Creek.

The water stored underground beneath the uplands of Kimball County is, in many respects, like the oil and gas resources

stored beneath the county. Pumping the water, like pumping the oil, will decrease the stored reserve because the natural recharge to the groundwater reservoir is quite small.

METHOD USED TO ESTIMATE POTENTIAL WELL YIELDS

Estimates of water yield from wells were made for each test-hole site according to a method devised by E. C. Reed, former director of the Conservation and Survey Division. This method assigns a value, called the coefficient of permeability, to each layer of water-saturated material penetrated in the test hole. Values assigned are within the following ranges:

Material	Coefficient of permeability (gallons per day per square foot)
Clay and silt	0 - 100
Sand or sandstone, very fine	100 - 300
Sand or sandstone, fine to medium	300 - 400
Sand, medium	400 - 600
Sand, medium to coarse	600 - 800
Sand, coarse	800 - 900
Sand, very coarse	900 - 1000
Sand and gravel	1000 - 2000

The value assigned to each layer is multiplied by the thickness of the layer to get another value, called the transmissivity, which expresses the ability of the layer to transmit water. The transmissivities of all the layers for the full water-bearing thickness are added together to determine the transmissivity for the formation at the test-hole site. A well drilled at the site to the base of the water-saturated material and properly constructed and developed should have a yield, in gallons per minute, of about one-eightieth of the numerical value of the transmissivity with a drawdown of 20 to 30 feet. Larger drawdowns would produce larger yields, and smaller drawdowns lesser yields. The method, although approximate, does give a means for estimating potential well yields. Inability to predict geologic changes in the subsurface because of insufficient information introduces larger errors in the map on plate 4 than does the subjective method for estimating well yields. The map should be considered a guide for further exploration, development, and management of the groundwater supplies of Kimball County.

APPENDIX

LOGS OF TEST HOLES

Test Hole 12N-53W-20aad
(Field No. 38-B-69)

Location: 725 ft south and 265 ft west of NE cor. sec. 20, T. 12 N., R. 53 W.
Ground altitude: 4,716 ft (a)
Depth to water: 155.1 ft (Sept. 9, 1969)

	Depth, in Feet	
	From	To
Quaternary System--undifferentiated		
Silt, moderately clayey, dark-brown; slightly clayey, dark grayish-brown below 1.5 ft-------	0	2.2
Silt, slightly clayey, slightly sandy, pale-brown, moderately calcareous; sand is very fine----------	2.2	4
Tertiary System:		
Pliocene Series-		
Ogallala Formation		
Limestone, sandy, pink; sand is very fine to medium----------	4	6.2
Sandstone, very fine- to medium-grained, marly areas, brown and pink, moderately consolidated----------	6.2	10
Marl, sandy, pink; sand is very fine to coarse; finer textured below 15 ft----------	10	18
Sand, very fine to medium, slightly silty, marly areas, in part lime-cemented----------	18	28
Marl, silty, pale-brown; interbedded sandstone--	28	28.5
Silty sand to sandy silt, slightly clayey, pale-brown, moderately calcareous; sand is very fine to fine----------	28.5	30
Silt, slightly clayey, brown, marly areas-------	30	32
Silty sand to sandy silt, slightly clayey, reddish-brown, some pink; sand is very fine to medium; some coarse below 38 ft----------	32	40
Sand, very fine to medium, with some coarse sand to fine gravel, slightly silty----------	40	48.5
Sand, gravelly; fine sand to coarse gravel, much coarse sand to fine gravel----------	48.5	60.5
Marl, sandy, white; sand is very fine to very coarse----------	60.5	61
Silt, sandy, brown; sand is very fine to medium, much very fine to fine----------	61	65
Sand, very fine to medium, much very fine to fine, slightly silty----------	65	70
Silty sand to sandy silt, slightly clayey, brown; sand is very fine----------	70	73.2
Marl, sandy, slightly silty, pinkish-white; sand is very fine to fine; some sandstone----------	73.2	74
Silty sand to sandy silt, slightly clayey, light-brown, some pink; sand is very fine to fine; some marly areas; interbedded sandstone-	74	79
Sand, very fine to fine, very silty, interbedded sandstone lenses----------	79	80.8

	Depth, in Feet	
	From	To
12N-53W-20aad--continued		
Tertiary-Pliocene-Ogallala--continued		
Marl, sandy, silty, pinkish-white; sand is very fine to fine	80.8	82.8
Silty sand to sandy silt, slightly clayey, brown, light-gray, and pinkish-gray; sand is very fine to fine; marly areas; interbedded sandstone lenses	82.8	125
Marly silt and siltstone, slightly clayey, white, slightly sandy; sand is very fine	125	126
Sand, very fine to fine, marly; some interbedded sandstone lenses	126	129.4
Tertiary System:		
Oligocene Series (White River Group)-		
Brule Formation		
Marl, silty, pinkish-gray and brown	129.4	130
Silt to siltstone, slightly clayey, brown	130	180

Test Hole 12N-54W-2bab
(Field No. 30-B-69)

Location: 1,645 ft east and 47 ft south of NW cor. sec. 2, T. 12 N., R. 54 W.
Ground altitude: 4,741 ft (a)
Depth to water: 241 ft (Sept. 2, 1969)

	Depth, in Feet	
	From	To
Quaternary System--undifferentiated		
Silt, slightly clayey, slightly sandy, dark-brown, moderately calcareous; sand is very fine to fine	0	2.3
Tertiary System:		
Pliocene Series-		
Ogallala Formation		
Siltstone, slightly clayey, slightly sandy, pink, very calcareous; sand is very fine to medium	2.3	3.3
Limestone, sandy, pink, some yellowish-red; sand is very fine to medium; some interbedded siltstone	3.3	5
Siltstone, slightly clayey, sandy, pink, some brown; sand is very fine to medium with some coarse; some interbedded sandstone	5	9
Sandstone, very fine- to medium-grained, pink, very calcareous, moderately consolidated; in part lime-cemented	9	9.5
Siltstone, slightly clayey, slightly sandy, pink, some light-brown, moderately calcareous-	9.5	10
Sandstone, very fine- to medium-grained, slightly silty, pink, moderately consolidated; sand is very fine to very coarse; a trace of fine gravel below 12 ft	10	15

	Depth, in Feet From	To
12N-54W-2bab--continued		
Tertiary-Pliocene-Ogallala--continued		
Siltstone, moderately sandy, slightly clayey, pink, moderately calcareous; sand is very fine to medium; marly areas from 15.5 to 17.5 ft; some fine gravel grains below 17.5 ft	15	18
Sandstone, very fine to very coarse-grained, trace of fine gravel, slightly silty, pink, well consolidated	18	23.3
Siltstone, very sandy, slightly clayey, pink; sand is very fine to medium; some coarse to very coarse to 25 ft	23.3	27.8
Sand, very fine to coarse, slightly silty; very fine to medium from 32 to 32.5 ft	27.8	35
Sandstone, very fine- to medium-grained with some coarse sand to fine gravel, brown, moderately consolidated; no fine gravel below 36.5 ft	35	37
Marl, sandy, pinkish-gray; sand is very fine to very coarse	37	40
Silt, very sandy, slightly clayey, light-brown; sand is very fine to very coarse; marly areas to 44 ft	40	47.5
Gravel, sandy; fine sand to coarse gravel, much very coarse sand to medium gravel	47.5	60
Sand, slightly gravelly; very fine sand to fine gravel, much medium to coarse sand	60	72
Silt, slightly clayey, slightly sandy, light reddish-brown; sand is very fine to medium	72	78
Sand, very fine to coarse, moderately silty; very fine to fine, slightly silty below 82 ft	78	85
Sand, slightly gravelly; very fine sand to very coarse gravel, much medium to very coarse sand	85	94.5
Silt, slightly clayey, reddish-brown, marly areas below 95 ft	94.5	99
Sand, very fine to coarse, moderately silty	99	100
Silt, very sandy, slightly clayey, brown; sand is very fine to fine; some marly areas	100	102
Sandy silt to silty sand, slightly clayey, light brown; sand is very fine to very coarse; some fine gravel from 106 to 109 ft; some marly areas below 109 ft	102	122
Sand, slightly gravelly; very fine sand to medium gravel, much coarse to very coarse sand	122	138
Silt, slightly clayey, slightly sandy, reddish-brown; sand is very fine to fine	138	140
Sand, very fine to medium, very silty, marly areas, light-brown	140	145

	Depth, in Feet From	To
12N-54W-2bab--continued		
Tertiary-Pliocene-Ogallala--continued		
Silty sand to sandy silt, slightly clayey, light-brown; sand is very fine to coarse -----	145	150
Sand, very fine to coarse, slightly silty; moderately silty below 154.5 ft ----------	150	161
Gravel, sandy; fine sand to coarse gravel, much coarse sand to fine gravel ----------	161	180
Sand, gravelly; fine sand to coarse gravel; much coarse sand to fine gravel to 185 ft; principally coarse to very coarse sand below 185 ft ----------	180	192.2
Silt, moderately sandy, slightly clayey, light-brown; sand is very fine to medium -----	192.2	198
Sand, very fine to very coarse with a little fine gravel ----------	198	210
Sand, gravelly; fine sand to coarse gravel, much coarse sand to fine gravel ----------	210	235
Sand, slightly gravelly; very fine sand to coarse gravel, much coarse to very coarse sand; much medium to very coarse sand below 240 ft ----------	235	250
Sand, gravelly; very fine sand to coarse gravel, much coarse sand to fine gravel ------	250	257.7
Tertiary System:		
Oligocene Series (White River Group)-		
Brule Formation		
Silt to siltstone, moderately sandy, slightly clayey, light-brown; sand is very fine; marly below 273.3 ft ----------	257.7	275
Silt to siltstone, slightly clayey, pinkish-gray, in part reddish-brown; slightly calcareous ----------	275	285
Silt to siltstone, slightly clayey, slightly sandy, yellowish-red, slightly calcareous; reddish-brown from 288 to 298 ft; light-brown below 298 ft; sand is very fine --------	285	300

Test Hole 12N-56W-2bba
(Field No. 20-B-69)

Location: 1,149 ft east and 39 ft south of NW cor. sec. 2, T. 12 N., R. 56 W.
Ground altitude: 4,974 ft (a)
Depth to water: 198.5 ft (July 28, 1969)

	Depth, in Feet From	To
Quaternary System--undifferentiated		
Silt, slightly clayey, slightly sandy, dark grayish-brown; sand is very fine to medium;		

	Depth, in Feet	
	From	To
12N-56W-2bba--continued		
Quaternary System-undifferentiated--continued		
moderately clayey below 1.5 ft; grayish-brown from 1.5 to 2.5 ft; brown below 2.5 ft	0	3
Tertiary System:		
Pliocene Series-		
Ogallala Formation		
Silty sand to sandy silt, slightly clayey, reddish-brown; sand is very fine to medium	3	6
Marl, sandy, light-brown to 10 ft; light yellowish-red below 10 ft; sand is very fine to coarse to 10 ft; very fine to medium below 10 ft	6	11
Silty sand to sandy silt, slightly clayey, yellowish-red; sand is very fine to medium, in part marly	11	13
Silty sand to sandy silt, slightly clayey, pinkish-gray, yellowish-red; sand is very fine to medium; some marly areas; some interbedded sandstone lenses	13	25.5
Silt to siltstone, slightly clayey, brown; some interbedded sandstone lenses below 27.5 ft	25.5	30
Silty sand to sandy silt,slightly clayey, reddish-brown, reddish-yellow, and brown; sand is very fine to fine; some sandstone, in part lime-cemented	30	34.8
Sandstone, very fine- to medium-grained, reddish-brown, light-gray and brownish-gray, moderately consolidated; in part lime-cemented; marly areas	34.8	39
Marl, sandy, light-gray; sand is very fine to fine	39	40
Silt, slightly clayey, slightly sandy, pale-brown; sand is very fine	40	41
Gravel, sandy; very fine sand to very coarse gravel, much coarse sand to medium gravel; some interbedded silty sandstone lenses below 50 ft	41	55
Sandstone, very fine- to fine-grained, brown, moderately consolidated; very fine to coarse sand below 60 ft	55	65
Silty sand to sandy silt, slightly clayey, light reddish-brown; sand is very fine to medium, some coarse sand to fine gravel	65	71.5
Silt, moderately sandy, slightly clayey, pinkish-gray; sand is very fine to fine	71.5	74.5
Sand, gravelly; very fine sand to fine gravel, much very fine to coarse sand	74.5	75

	Depth, in Feet	
	From	To
12N-56W-2bba--continued		
Tertiary-Pliocene-Ogallala--continued		
Silty sand, marly, brown; sand is very fine to medium; some sandstone	75	78
Marl, sandy, silty, brown and pinkish-gray; sand is very fine to medium	78	80
Silt, very sandy, slightly clayey, marly, pinkish-gray and reddish-brown; sand is very fine to medium	80	91
Gravel, sandy; very fine sand to very coarse gravel, much coarse sand to medium gravel; coarse sand to coarse gravel below 95 ft	91	102.8
Silt, very clayey, moderately sandy, reddish-brown; sand is very fine to fine; very sandy below 105 ft; sand is very fine to coarse	102.8	109.5
Sand, coarse to very coarse	109.5	110
Gravel, sandy; coarse sand to medium gravel	110	115
Sand, gravelly; fine sand to coarse gravel; interbedded silt lens	115	120
Gravel, sandy; fine sand to coarse gravel, much coarse sand to medium gravel	120	137.5
Silt, very sandy, moderately clayey, light reddish-brown; sand is very fine to very coarse	137.5	144
Silt, very clayey, slightly sandy, reddish-brown; sand is very fine to very coarse	144	152
Sand, gravelly; coarse sand to fine gravel with some medium gravel	152	168
Silt, moderately clayey, slightly sandy, reddish-brown; sand is very fine to fine	168	182.3
Sand, very fine to medium, slightly silty, slightly clayey	182.3	185.5
Sand, slightly gravelly; very fine sand to fine gravel, much medium to very coarse sand; some silt lenses below 190 ft	185.5	200
Marl, very sandy, silty, pinkish-white; sand is fine to very coarse	200	202.5
Silt, very sandy, moderately clayey, reddish-brown and brown; sand is very fine to medium	202.5	213.5
Sand, gravelly; fine sand to medium gravel, much coarse sand to fine gravel; marly at base	213.5	228
Silt, moderately clayey, slightly sandy, reddish-brown; sand is very fine to coarse	228	232
Sand, gravelly; medium sand to medium gravel; interbedded silt lenses to 235 ft; mostly fine to coarse sand below 235 ft	232	239.5
Sand, very fine to fine, moderately silty	239.5	240

	Depth, in Feet	
	From	To
12N-56W-2bba--continued		
Tertiary System		
Oligocene Series (White River Group)-		
Brule Formation		
Silt, moderately sandy, slightly clayey, light-brown; sand is very fine to fine	240	244.1
Marl, very sandy, pinkish-white; sand is very fine to fine; some interbedded sandstone	244.1	247
Silt to siltstone, slightly clayey, reddish-brown; some marly areas; some very fine sand	247	249
Silt, slightly clayey, marly, sandy, light-brown and light yellowish-brown; sand is very fine to fine	249	254
Silt to siltstone, slightly clayey, light-brown; some marly areas; pinkish-brown below 255 ft	254	270
Silt to siltstone, moderately clayey, slightly sandy, light yellowish-brown; sand is very fine to fine	270	280
Silt to siltstone, moderately clayey, slightly sandy, pinkish-brown; light reddish-brown from 285 to 289.5 ft; sand is very fine to fine	280	295
Silt to siltstone, moderately clayey, slightly sandy, pale-brown, slightly calcareous; sand is very fine to fine; very sandy from 305 to 307 ft	295	320

Test Hole 12N-56W-23bbb
(Field No. 37-B-69)

Location: 656 ft south and 103 ft east of NW cor. sec. 23, T. 12 N., R. 56 W.
Ground altitude: 4,979 ft (a)
Depth to water: 104.8 (Sept. 5, 1969)

	Depth, in Feet	
	From	To
Quaternary System--undifferentiated		
No sample	0	2
Silt, slightly clayey, slightly sandy, pale-brown; sand is fine to very coarse with a little gravel	2	2.5
Tertiary System:		
Pliocene Series-		
Ogallala Formation		
Gravel, sandy; fine sand to very coarse gravel, silty, much very coarse sand to coarse gravel	2.5	5
Sand, gravelly; fine sand to very coarse gravel, much coarse sand to fine gravel	5	40

	Depth, in Feet From	To
12N-56W-23bbb--continued		
Tertiary-Pliocene-Ogallala--continued		
Gravel, sandy; fine sand to coarse gravel, much very coarse sand to medium gravel ------	40	50
Sand, gravelly; very fine sand to coarse gravel, much coarse sand to fine gravel; below 70 ft, marly areas, much coarse to very coarse sand ----------	50	76.5
Marl, sandy, silty, white; sand is fine to coarse ----------	76.5	77
Silt, moderately clayey, sandy, pinkish-gray; brown from 81.5 to 87 ft; pinkish-brown below 87 ft; sand is fine to coarse to 81.5 ft; very fine to fine below 81.5 ft ----	77	91
Sand, slightly gravelly; fine sand to fine gravel, much coarse to very coarse sand -----	91	112.2
Tertiary System:		
Oligocene Series (White River Group)-		
Brule Formation		
Silt, moderately clayey, light-brown; pink from 115 - 116.2 ft; very sandy below 116.2 ft, sand is very fine ----------	112.2	126.2
Marl, sandy, silty, pinkish-gray; sand is very fine to fine ----------	126.2	126.4
Silt to siltstone, clayey, sandy, light-brown, some yellowish-brown; some marly areas below 131.1 ft ----------	126.4	132.8
Silt to siltstone, marly, clayey, light-brown and pinkish-gray ----------	132.8	135.5
Silt to siltstone, clayey, light-brown, slightly calcareous ----------	135.5	200

Test Hole 12N-59W-4add
(Field No. 1-B-69)

Location: About 2,080 ft south and 1,226 ft east of NE cor. sec. 4, T. 12 N., R. 59 W.
Ground altitude: 5,358 ft (Pine Bluff 7.5 minute quadrangle)
Depth to water: 149.4 ft (June 23, 1969)

	Depth, in Feet From	To
Quaternary System--undifferentiated		
No sample ----------	0	0.9
Silt, slightly clayey, slightly sandy, dark-brown, some limestone fragments ----------	0.9	3
Silt, slightly clayey, light-brown, very calcareous, trace of sand ----------	3	3.3

12N-59W-4add--continued	Depth, in Feet From	To
Tertiary System:		
Pliocene Series-		
Ogallala Formation		
Sand and gravel; lime-cemented	3.3	15
Sandstone, very fine- to medium-grained, silty, light reddish-brown, slightly calcareous, moderately consolidated; some limy grains	15	30
Marl, sandy, pinkish-gray; sand is very fine to fine	30	35
Siltstone, moderately sandy, pinkish-gray, very calcareous; sand is very fine to fine	35	39
Siltstone, sandy, lime-cemented, pink, yellowish-red, and reddish-brown; sand is very fine to fine	39	48
Sandstone, very fine- to medium-grained, silty, brown and pinkish-gray, very calcareous, poorly consolidated; some interbedded siltstone and limestone lenses	48	70
Sand and gravel, very fine sand to fine gravel-	70	71.3
Siltstone, sandy, brown and pinkish-gray, very calcareous; sand is very fine to fine; some interbedded silty sandstone lenses	71.3	77.2
Sandstone, very fine- to fine-grained, silty, pinkish-gray and light-brown, very calcareous, poorly consolidated	77.2	79.5
Marl, silty, sandy, pinkish-gray, sand is very fine to fine	79.5	80
Sandstone, very fine- to fine-grained, silty, marly, pinkish-gray, some brown, very calcareous, moderately consolidated	80	108.8
Tertiary System:		
Oligocene Series (White River Group)-		
Brule Formation		
Siltstone, clayey, pink; light-brown below 110 ft; slightly calcareous	108.8	123.5
Siltstone, clayey, pinkish-gray, moderately calcareous; limy areas	123.5	124
Siltstone, clayey, brown; some reddish-brown and light yellowish-brown below 145 ft	124	170

Test Hole 12N-59W-21aac
(Field No. 36-B-69)

Location: About 729 ft south and 1,100 ft west of NE cor. sec. 21, T. 12 N., R. 59 W.
Ground altitude: 5,378 ft (Pine Bluffs 7.5 minute quadrangle)
Depth to water unknown; Test Hole plugged at 28.5 ft (Sept. 7, 1969)

	Depth, in Feet	
	From	To
Quaternary System-undifferentiated		
Silt, slightly clayey, slightly sandy, dark grayish-brown; sand is very fine with some fine to medium; some limy grains	0	1
Tertiary System:		
Pliocene Series-		
Ogallala Formation		
Sandstone, very fine- to fine-grained, silty, light grayish-brown and light-gray, very calcareous, poorly consolidated	1	2.5
Sandstone, very fine- to fine-grained with a trace of medium to coarse, pale-brown, some light-gray and pinkish-gray, moderately calcareous, moderately consolidated	2.5	15.5
Gravel, sandy; very fine sand to medium gravel, principally siltstone and sandstone	15.5	18.6
Tertiary System:		
Oligocene Series (White River Group)-		
Brule Formation		
Silt to siltstone, slightly clayey, slightly sandy, pink, slightly calcareous; sand is very fine	18.6	21
Silt to siltstone, slightly clayey, slightly sandy, light-brown, slightly calcareous; light yellowish-brown from 40 to 45 ft and below 50 ft	21	100

Test Hole 13N-53W-21bbb
(Field No. 1-ANB-70)

Location: 23 ft south and 47 ft east of NW cor. sec. 21, T. 13 N., R. 53 W.
Ground altitude: 4,680 ft (a)
Depth to water: 249.1 ft (Oct. 17, 1970)

	Depth, in Feet	
	From	To
Quaternary System-undifferentiated		
Silt, slightly clayey, dark grayish-brown	0	1
Tertiary System:		
Pliocene Series-		
Ogallala Formation		
Limestone, sandy, light-gray; sand is very fine to fine	1	5

	Depth, in Feet From	To
13N-53W-21bbb--continued		
Tertiary-Pliocene-Ogallala--continued		
Sand, silty, very fine- to fine-grained, moderately silty, light-brown, poorly consolidated	5	10
Limestone, sandy, light-gray; sand is very fine to fine, some medium; trace of coarse to very coarse sand from 15 to 20 ft; much very coarse sand with a little fine gravel below 20 ft	10	25
Sandstone, very fine- to fine-grained, some medium, light-brown, moderately calcareous, moderately consolidated	25	30
Limestone, sandy, light-gray, light-brown; sand is very fine to coarse with a little very coarse; trace of rootlets	30	35
Sandstone, very fine- to fine-grained, moderately silty, gray to pinkish-gray, very calcareous, moderately consolidated	35	40
Limestone, sandy, pale-brown; sand is very fine to fine	40	45
Sand, very fine to very coarse, in part lime-cemented	45	50
Gravel, sandy; very fine sand to medium gravel, some coarse gravel	50	65
Sand, very fine to very coarse, with a little fine gravel	65	70
Sand, gravelly; very fine sand to fine gravel, little medium gravel	70	88
Sandstone, very fine- to fine-grained, moderately silty, brown, moderately consolidated--	88	95
Silt to siltstone, moderately clayey, pinkish-gray, interbedded limestone and sandstone lenses	95	105
Sand, very fine to very coarse, moderately silty, some limy lenses	105	110
Silt, slightly clayey, light brownish-gray, some pink; interbedded lime-cemented sandstone lens below 118 ft	110	120
Silt, moderately clayey, pinkish-gray	120	125
Sand, very fine to very coarse, trace of fine gravel	125	135
Sand, slightly gravelly; very fine sand to fine gravel, trace of medium gravel	135	145
Sand, very fine to very coarse, trace of fine gravel	145	150
Silt, very sandy, slightly clayey, light-gray; sand is very fine to fine, little medium	150	160
Silt to siltstone, moderately clayey, light olive-gray	160	163

	Depth, in Feet	
	From	To
13N-53W-21bbb--continued		
Tertiary-Pliocene-Ogallala--continued		
Sand, gravelly; very fine sand to fine gravel, with some medium to coarse gravel	163	165
Sand, very fine to very coarse with a trace of fine gravel	165	185
Sand, gravelly; very fine sand to fine gravel with a little medium gravel; silt lens 186 to 187 ft; some medium to coarse gravel with a trace of very coarse gravel below 190 ft	185	195
Sand, very fine to very coarse, a little fine gravel	195	200
Sand, gravelly; very fine sand to fine gravel, some medium gravel; interbedded silt lenses, in part bentonitic; less gravel from 205 to 210 ft; trace of coarse gravel below 210 ft	200	222
Silt, moderately clayey, pinkish-gray	222	229
Sand, gravelly; very fine sand to fine gravel, a little medium gravel	229	235
Sand, very fine to very coarse, with a trace of fine gravel; interbedded clay lens	235	240
Sand, gravelly; very fine sand to fine gravel, with a little medium gravel	240	245
Sand, very fine to very coarse, with a trace of gravel; interbedded silt lenses	245	250
Sand, slightly gravelly; very fine sand to fine gravel; interbedded silt lens	250	255
Gravel, sandy; very fine sand to fine gravel, some medium gravel	255	260
Sand, gravelly; very fine sand to fine gravel, some medium gravel	260	264
Tertiary System		
Oligocene Series (White River Group)-		
Brule Formation		
Silt, very sandy, slightly clayey, light brownish-gray, moderately calcareous; sand is very fine to fine; limy areas	264	270
Silt to siltstone, slightly clayey, slightly sandy, brown, slightly calcareous; sand is very fine to fine	270	280
Silt to siltstone, slightly clayey, brown, moderately calcareous to 285 ft; slightly calcareous below 285 ft; some limy areas; little very fine sand	280	300

Test Hole 13N-53W-34ddd
(Field No. 31-B-69)

Location: 185 ft north and 15 ft west of SE cor. sec. 34, T. 13 N., R. 53 W.
Ground altitude: 4,560 ? (a)
Depth to water unknown Test Hole caved at 70.5 ft (Sept. 2, 1969

	Depth, in Feet	
	From	To
Quaternary System-undifferentiated		
Silt, slightly clayey, slightly sandy, dark grayish-brown, slightly calcareous; sand is very fine to fine with some gravel grains-	0	1
Tertiary System:		
Pliocene Series-		
Ogallala Formation		
Siltstone to limestone, sandy, silty, brown, moderately calcareous; sand is very fine to fine ----------	1	3
Sand, gravelly; very fine sand to coarse gravel ----------	3	13.5
Gravel, sandy, very fine sand to very coarse gravel ----------	13.5	19.5
Sand, very fine to very coarse with some fine to coarse gravel ----------	19.5	20
Sandstone, very fine- to medium-grained, slightly silty, light-brown, slightly calcareous, moderately consolidated; sand is very fine to very coarse below 25 ft ----------	20	32
Silt, moderately clayey, sandy, brown and light reddish-brown; sand is very fine to fine ----------	32	36
Silt, very sandy, slightly clayey, light grayish-brown and light-brown; sand is very fine to fine ----------	36	40
Sandstone, very fine- to fine-grained with some medium to coarse, light-brown, moderately consolidated ----------	40	46
Silt, very sandy, slightly clayey, brown, some light gray; sand is very fine to fine; some interbedded sandstone lenses ----------	46	53
Sandy siltstone and silty sand, slightly clayey, brown; some yellowish-brown below 66.2 ft, slightly calcareous; sand is very fine to fine with some medium ----------	53	70
Sand, very fine to medium, much very fine to fine ----------	70	76

	Depth, in Feet From	To
13N-53W-34ddd--continued		
Tertiary System:		
Pliocene Series-		
Ogallala Formation		
Silt to siltstone, slightly clayey, light yellowish-brown to 85 ft; light brown from 85 to 90 ft; light reddish-brown below 90 ft	76	110

Test Hole 13N-54W-6bbb
(Field No. 22-B-69)

Location: 13.5 ft south and 8.5 ft east of NW cor. sec. 6, T. 13 N., R. 54 W.
Ground altitude: 4,826 ft
Depth to water: 205.9 ft (Sept. 2, 1969)

	Depth, in Feet From	To
Quaternary System - undifferentiated		
No sample	0	2
Sand, very fine to medium, very silty	2	3.5
Tertiary System:		
Pliocene Series-		
Ogallala Formation		
Limestone, sandy, pinkish-white; sand is very fine to medium	3.5	5
Sandstone, very fine- to medium-grained, some coarse to very coarse, pinkish-gray and light-brown, moderately calcareous, poorly consolidated	5	13
Marl, sandy, light-brown and pinkish-white; sand is very fine to very coarse	13	15.2
Gravel, sandy; fine sand to very coarse gravel-	15.2	21.9
Silt, moderately clayey, dark-brown; reddish-brown and sandy below 22.2 ft; sand is very fine to medium; some marly areas	21.9	30
Sand, very fine to medium, silty	30	31
Sandstone, very fine- to medium-grained, some coarse to very coarse, reddish-brown, very calcareous, moderately consolidated; pinkish-white and marly below 35 ft	31	36.5
Gravel, sandy; fine sand to medium gravel, much coarse sand to medium gravel	36.5	43.5
Silt, slightly clayey, slightly sandy, reddish-brown, some brown and yellowish-brown; sand is very fine	43.5	51
Sand, very fine to very coarse, slightly silty	51	55
Gravel, sandy; fine sand to medium gravel, much coarse sand to medium gravel; coarse sand to coarse gravel from 60 to 70 ft;		

	Depth, in Feet	
	From	To
13N-54W-6bbb--continued		
Tertiary-Pliocene-Ogallala--continued		
very coarse sand to coarse gravel below 70 ft; lime-cemented below 82.2 ft ----------	55	83.4
Silt, slightly clayey, slightly sandy, reddish-brown; brown below 84 ft; sand is very fine; very sandy from 90 to 91 ft; marly areas below 91 ft ----------	83.4	91
Silty sand to sandy silt, slightly clayey, brown; sand is very fine to fine ----------	91	98.5
Sand, very fine to very coarse, trace of fine gravel, much fine to coarse ----------	98.5	100
Sand, gravelly; fine sand to medium gravel, much medium sand to medium gravel ----------	100	110
Gravel, sandy; fine sand to coarse gravel, much very coarse sand to coarse gravel ------	110	117.2
Silt, slightly clayey, slightly sandy, brown; sand is very fine to fine ----------	117.2	125
Sand, very fine to very coarse, moderately silty ----------	125	127
Sand, gravelly; very fine sand to medium gravel; no medium gravel below 130 ft; much medium sand to fine gravel from 130 to 135 ft; much fine to coarse sand below 135 ft ----------	127	136.5
Sand, very fine to very coarse, very silty; moderately silty below 140 ft; sand is very fine to medium from 140 to 141 ft ------	136.5	142.2
Silty sand to sandy silt, slightly clayey, brown; sand is very fine to coarse; very fine to medium below 146.5 ft; some marl below 153.8 ft ----------	142.2	155
Marl, sandy, light-gray and pale-brown; sand is very fine to fine; pinkish-white below 157 ft ----------	155	157.3
Silt, moderately sandy, slightly clayey, brown; sand is very fine to medium; marly from 162.2 to 163.5 ft; sand is very fine to very coarse with a trace of gravel below 163.5 ft ----------	157.3	165
Sand, very fine to coarse, slightly silty, slightly clayey; trace of gravel below 170.9 ft ----------	165	175
Sand, gravelly; fine sand to fine gravel, much coarse to very coarse sand; some medium gravel from 185 to 190 ft; principally coarse sand to fine gravel below 90 ft-	175	207.5
Marl, sandy to gravelly, white ----------	207.5	209
Tertiary System:		
Oligocene Series (White River Group)-		
Brule Formation		
Silt, slightly clayey, slightly sandy, light-brown, slightly calcareous; sand is very		

	Depth, in Feet	
	From	To
13N-54W-6bbb--continued		
Tertiary-Oligocene-Brule--continued		
fine to fine; pink from 210 to 212 ft and below 214.5 ft	209	215
Silt, slightly clayey, light yellowish-brown; pale-brown below 230 ft; slightly calcareous	215	260

Test Hole 13N-54W-31cc
(Field No. 21-B-69)

Location: 14 ft north and 8 ft east of SW cor. sec. 31, T. 13 N., R. 54 W.
Ground altitude: 4,871 ft (a)
Depth to water: 308.3 ft (Sept. 9, 1969)

	Depth, in Feet	
	From	To
Quaternary System-undifferentiated		
Silt, slightly clayey, moderately sandy, dark brown; sand is very fine to medium	0	1
Silt, slightly clayey, slightly sandy, dark grayish-brown; sand is very fine to very coarse with a trace of gravel; dark brown from 1.5 to 2.0 ft	1	5.0
Tertiary System:		
Pliocene Series-		
Ogallala Formation		
Sandstone, very fine- to medium-grained, silty, light-brown, very calcareous, poorly consolidated; reddish-yellow below 9 ft; some clayey sand; sand is very fine to coarse	5.0	10
Sandstone, slightly gravelly; very fine sand to fine gravel, silty, reddish-brown, very calcareous, poorly consolidated; pinkish-gray below 11.9 ft; in part marly	10	15
Gravel, sandy; very fine sand to coarse gravel; some interbedded sandstone and sandy clay lenses	15	25.5
Silt, moderately clayey, moderately sandy, reddish-brown; sand is very fine to medium; light-brown below 28.5 ft, slightly gravelly	25.5	30
Silt, slightly clayey, slightly sandy, brown; sand is very fine to fine; some interbedded sand lenses; reddish-brown below 33.5 ft	30	41.2
Silt, very sandy, slightly clayey, brown; reddish-brown from 50 to 51 ft; sand is very fine to very coarse with some coarser grains; in part sandy silt	41.2	53.8

	Depth, in Feet	
	From	To
13N-54W-31cc--continued		
Tertiary-Pliocene-Ogallala--continued		
Silty sand to sandy silt, slightly clayey, light-brown	53.8	57.7
Sandstone, very fine- to coarse-grained, pinkish-gray, very calcareous, well consolidated; some marl; sand is very fine to coarse	57.7	59.5
Silty sand to sandy silt, slightly clayey pinkish-gray; sand is very fine to coarse, in part marly	59.5	61.5
Silt, slightly clayey, slightly sandy, brown; sand is very fine	61.5	65
Sand, gravelly; very fine sand to coarse gravel; interbedded silty clay lenses	65	71.3
Silty sand to sandy silt, slightly clayey, light reddish-brown; sand is very fine to medium	71.3	74
Silt, moderately sandy, slightly clayey, reddish-yellow; reddish-brown below 75 ft; sand is very fine to coarse with a trace of fine gravel	74	78
Gravel, sandy; very coarse sand to fine gravel	78	85
Sand, gravelly; medium sand to fine gravel	85	104.5
Silt, moderately clayey, moderately sandy, reddish-brown; yellowish-red below 107.5 ft; sand is very fine to medium	104.5	109
Silty sand to sandy silt, moderately clayey, reddish-brown; pinkish-gray from 111.5 to 115.1 ft; sand is very fine to coarse with some fine gravel below 111.5 ft	109	120
Silty sand to sandy silt, moderately clayey, brown; pinkish-gray from 125 to 127 ft; reddish-brown below 127 ft; sand is very fine to coarse with some coarser grains	120	131.5
Sand, gravelly; coarse sand to fine gravel, much medium to coarse sand; some marly areas	131.5	143
Silt, moderately clayey, reddish-brown; very sandy below 145 ft; sand is very fine to coarse	143	150
Sand, fine to coarse	150	155
Sand, slightly gravelly; fine sand to medium gravel, much medium to coarse sand	155	162.5
Silt, moderately sandy, slightly clayey, brown; sand is very fine to medium	162.5	165
Sand, gravelly; very fine sand to medium gravel, much coarse sand and fine gravel; some coarse gravel from 170 to 180 ft; some marly and silty areas from 175 to		

	Depth, in Feet From	To
13N-54W-31cc--continued		
Tertiary-Pliocene-Ogallala--continued		
190 ft; much medium sand to fine gravel from 190 to 200 ft	165	207.8
Silt, moderately clayey, brown	207.8	213
Sand, gravelly; medium sand to fine gravel; coarse sand to fine gravel below 215 ft	213	235
Silt, moderately clayey, brown; very sandy to sandy from 238.5 ft to 240.8 ft	235	248
Sand, slightly gravelly; fine sand to medium gravel, much medium to very coarse sand	248	250
Gravel, sandy; fine sand to medium gravel, much very coarse sand to medium gravel	250	255
Sand, gravelly; fine sand to fine gravel, much coarse sand to fine gravel; in part coarse sand to medium gravel	255	322.3
Tertiary System:		
Oligocene Series (White River Group)-		
Brule Formation		
Silt, moderately clayey, slightly sandy, light reddish-brown, slightly calcareous; sand is very fine	322.3	340
Silty sand to sandy silt, slightly clayey, light reddish-brown; some yellowish-red and pinkish-white from 345 to 350 ft; slightly calcareous; sand is very fine to fine	340	370

Test Hole 13N-57W-6bbb
(Field No. 9-B-69)

Location: 3 ft south and 30 ft east of NW cor. sec. 6, T. 13 N., R. 57 W.
Ground altitude: 5,170 ft (a)
Depth to water unknown; Test hole caved at 129 ft; E-log 190 ft (July 8, 1969)

	Depth, in Feet From	To
Quaternary System-undifferentiated		
Silt, very sandy, slightly clayey, dark-brown, slightly calcareous	0	0.5
Tertiary System:		
Pliocene Series-		
Ogallala Formation		
Gravel, sandy; very fine sand to very coarse gravel	0.5	10
Limestone, very sandy, pinkish-gray and light reddish-brown; sand is very fine to medium	10	12
Silty sand to sandy silt, slightly clayey, marly, yellowish-red; sand is very fine to coarse	12	20

	Depth, in Feet	
	From	To
13N-57W-6bbb--continued		
Tertiary-Pliocene-Ogallala--continued		
Sandstone, very fine- to very coarse-grained, slightly gravelly, reddish-brown, slightly calcareous, poorly consolidated; interbedded silty sand lenses below 25 ft	20	33.7
Sandstone, very fine- to coarse-grained, pinkish-gray, very calcareous, moderately consolidated	33.7	35.2
Sandstone, very fine- to coarse-grained, slightly gravelly, reddish-brown, very calcareous, moderately consolidated; some marly areas	35.2	52
Silty sand to sandy silt, marly, light reddish-brown and pink; sand is very fine to coarse	52	60.3
Sand, gravelly; very fine sand to medium gravel	60.3	66.5
Silt, moderately sandy, slightly clayey, pinkish-gray, moderately calcareous; sand is very fine	66.5	67
Sand, very fine to medium, with some coarse sand to fine gravel; some marly areas	67	77.5
Silt, slightly clayey, slightly sandy, pink and yellowish-red; sand is very fine to medium; in part very sandy	77.5	83.5
Sand, very fine to fine, slightly silty; marly areas; very fine to medium below 85 ft	83.5	93
Limestone, sandy, silty, white; sand is very fine	93	93.3
Silt, moderately sandy, slightly clayey, white, some yellow; sand is very fine to fine	93.3	96.5
Sand, gravelly; very fine sand to fine gravel; some coarser gravel below 110 ft	96.5	115
Silt, slightly clayey, slightly sandy, light-brown, moderately calcareous; sand is very fine	115	118.7
Silt, moderately clayey, light reddish-brown, some yellowish-red and light-brown; some very fine sand below 120 ft	118.7	130
Silt to siltstone, slightly clayey, slightly sandy, brown; sand is very fine to fine	130	142.5
Sand, slightly gravelly; very fine sand to fine gravel	142.5	146
Silt, slightly clayey, reddish-brown	146	153
Sandstone, very fine- to medium-grained, light brown and pinkish-gray, moderately calcareous, poorly consolidated; marly from 158.7 to 160 ft	153	160

	Depth, in Feet	
	From	To
13N-57W-6bbb--continued		
Tertiary-Pliocene-Ogallala--continued		
Silt, slightly clayey, pink, slightly calcareous	160	164.7
Sand, very fine to very coarse, some gravel grains; very fine to medium below 164.9 ft	164.7	165
Sand, gravelly; very fine sand to fine gravel; medium sand to coarse gravel from 175 ft to 185 ft; coarse sand to coarse gravel below 185 ft	165	191
Silty sand to sandy silt, slightly clayey, pinkish-gray; sand is very fine to fine; marly below 195 ft	191	200
Sand, gravelly; very fine sand to fine gravel	200	207
Sand, very fine to medium, silty; interbedded marly lenses	207	215
Sand, very fine to fine, moderately silty; some claystone gravel; sand is very fine to coarse from 225 to 230 ft	215	230
Silt, slightly clayey, slightly sandy, light-brown; sand is very fine to fine	230	235
Sand, very fine to medium, silty, marly	235	240
Silt, moderately clayey, light-brown, slightly calcareous; slightly sandy below 245.6 ft; light-gray and light-brown below 248 ft	240	262.7
Sand and gravel; very fine sand to medium gravel; many re-worked fragments	262.7	267
Tertiary System		
Oligocene Series (White River Group)-		
Brule Formation		
Silt to siltstone, slightly clayey, light reddish-brown and reddish-yellow	267	285
Silt to siltstone, slightly clayey, light-brown, light reddish-brown, some yellowish-brown; slightly calcareous	285	335
Sand, very fine, silty	335	340
Claystone, silty, yellowish-red and reddish-brown, slightly calcareous	340	360
Sand, very fine to medium, slightly silty, some claystone fragments, slightly calcareous	360	375
Silt, moderately clayey, light reddish-brown, slightly calcareous	375	380
Clay, silty, light reddish-brown, slightly calcareous; some claystone	380	400

Test Hole 13N-57W-31ccc
(Field No. 10-B-69)

Location: 18 ft north and 54 ft west of SW cor. sec. 31, T. 13 N., R. 57 W.
Ground altitude: 5,212 ft (a)
Depth to water: 111.9 ft (July 8, 1969)

	Depth, in Feet	
	From	To
Quaternary System-undifferentiated		
No sample	0	0.5
Silt, slightly clayey, grayish-brown, moderately calcareous	0.5	1.5
Gravel, sandy	1.5	6
Tertiary System:		
Pliocene Series-		
Ogallala Formation		
Silt, very sandy, slightly clayey, pinkish-gray to reddish-brown, moderately calcareous; sand is very fine to coarse	6	7
Sandstone, very fine- to medium-grained, light-brown and pinkish-gray, moderately calcareous, poorly consolidated; below 10.5 ft, in part slightly silty with marly areas	7	17.1
Silt, very sandy, slightly clayey, pinkish-gray and reddish-brown, moderately calcareous; sand is very fine to medium; marly from 19 to 19.5 ft; no medium sand below 19.5 ft	17.1	21
Sand, very fine to medium, some gravel grains	21	25
Sand, gravelly; very fine sand to fine gravel	25	27.8
Sand, very fine to coarse, some gravel grains; silty below 28.8 ft	27.8	29
Sand, very fine to medium, marly, some gravel grains	29	34.5
Gravel sandy; fine sand to medium gravel, much coarse sand; marly from 39.4 to 39.8 ft	34.5	40
Silt, very sandy, slightly clayey, brown, some limy areas; sand is very fine to fine	40	55
Sand, very fine to fine, silty	55	60.5
Sand, gravelly; fine sand to medium gravel, mostly medium sand to fine gravel	60.5	70
Sand, gravelly; fine sand to medium gravel; mostly fine sand to fine gravel below 85 ft	70	90
Gravel, sandy; coarse sand to fine gravel; very coarse sand to medium gravel from 95 to 100 ft; medium sand to fine gravel below 100 ft	90	105
Sand, gravelly; medium sand to fine gravel; lime-cemented below 108.8 ft; mostly coarse sand to fine gravel	105	112.8
Gravel, sandy; coarse sand to medium gravel; very fine sand to medium gravel from		

	Depth, in Feet	
	From	To
13N-57W-31ccc--continued		
Tertiary-Pliocene-Ogallala--continued		
115 to 116.3 ft; lime-cemented below 116.3 ft; medium sand to fine gravel below 118 ft	112.8	121.3
Tertiary System:		
Oligocene Series (White River Group)-		
Brule Formation		
Marl, silty, pinkish-gray	121.3	121.4
Silt, slightly clayey, slightly sandy, brown; marly areas; sand is very fine	121.4	128.4
Marly, silty, pinkish-gray	128.4	130
Silt to siltstone, slightly clayey, light-brown, slightly calcareous; some pinkish-gray from 131 to 135 ft	130	170

Test Hole 13N-57W-36ddd
(Field No. 11-B-69)

Location: 20 ft north and 56 ft west of SE cor. sec. 36, T. 13 N., R. 57 W.
Ground altitude: 5,115 ft (a)
Depth to water: 143.9 ft (July 7, 1969)

	Depth, in Feet	
	From	To
Quaternary System-undifferentiated		
Silt, slightly clayey, moderately sandy, slightly gravelly, dark grayish-brown; very fine sand to fine gravel; many limestone fragments	0	1
Silt, slightly clayey, sandy, gravelly, grayish-brown to 2.2 ft; moderately calcareous; limestone fragments; pale-brown below 2.2 ft	1	3
Gravel, sandy, silty	3	7
Tertiary System:		
Pliocene Series-		
Ogallala Formation		
Sandstone, very fine- to coarse-grained, very silty, light reddish-brown, some pink, poorly consolidated	7	11
Sand, gravelly; very coarse sand to very coarse gravel, with interbedded clayey silt lenses	11	19.3
Sand, very fine to medium, silty, in part lime-cemented; sand is very fine to medium	19.3	23.5
Silt, slightly clayey, sandy, light yellowish-red, reddish-brown and pink, slightly calcareous; sand is very fine to medium; some coarse sand from 24.5 to 26 ft	23.5	27

	Depth, in Feet	
	From	To
13N-57W-36ddd--continued		
Tertiary-Pliocene-Ogallala--continued		
Sand, gravelly; coarse sand to fine gravel with some medium gravel	27	57
Silt, clayey, sandy, light reddish-brown to 63.3 ft; brown below 63.3 ft; sand is very fine to fine with some coarser grains below 62.2 ft	57	66
Sand, gravelly; fine sand to fine gravel, mostly coarse sand to fine gravel	66	72.5
Silt, very clayey, reddish-brown	72.5	76
Silt, clayey, very sandy, reddish-brown to light-brown; sand is very fine to fine in part, some medium	76	89
Sand, very fine to medium, silty; some thin clayey and limy lenses	89	100
Sand, gravelly; very fine sand to fine gravel; silty from 100 to 103 ft; mostly very fine to very coarse sand to 105 ft; mostly coarse sand to fine gravel below 105 ft	100	109.5
Silt, clayey, very sandy, brown; sand is very fine to medium	109.5	111.1
Sand, very fine to coarse with a trace of silt	111.1	120
Sand, gravelly; very fine sand to fine gravel, mostly medium sand to fine gravel	120	131
Sandstone, very fine- to coarse-grained, moderately silty, brown, moderately consolidated	131	134.9
Sand, slightly gravelly; very fine sand to fine gravel	134.9	138.4
Sandstone, very fine to fine-grained, silty, marly, pinkish-gray, very calcareous, moderately consolidated	138.4	140
Marl, silty, sandy, pinkish-gray; sand is very fine to medium	140	144.5
Tertiary System:		
Oligocene Series (White River Group)-		
Brule Formation		
Silt to siltstone, clayey, slightly sandy, light-brown, moderately calcareous; sand is very fine	144.5	150
Silt, slightly clayey, sandy, light reddish-brown; light pinkish-gray from 151 to 152.4 ft; light-brown below 152.4 ft; moderately calcareous; sand is very fine to fine	150	155
Silt to siltstone, slightly clayey, slightly sandy, light yellowish-brown light-brown with a little reddish-brown, slightly calcareous; sand is very fine	155	200

Test Hole 14N-53W-3aaa
(Field No. 33-B-69)

Location: 113 ft south and 96 ft west of NE cor. sec. 3, T. 14 N., R. 53 W.
Ground altitude: 4,450 ft (a)
Depth to water unknown; Test Hole caved at 81 ft (Sept. 7, 1969)

	Depth, in Feet	
	From	To
Quaternary System-undifferentiated		
Silt, slightly clayey, slightly sandy, very dark-brown, moderately calcareous; sand is very fine to fine	0	2.5
Silt, very sandy, slightly clayey, brown, moderately calcareous; sand is very fine to fine; grayish-brown below 5 ft	2.5	6.8
Silt, slightly clayey, dark grayish-brown, moderately calcareous; moderately clayey, dark-brown below 7.5 ft	6.8	13.5
Silty sand to sandy silt, slightly clayey, pale-brown; sand is very fine, few gravel grains	13.5	15
Gravel, sandy; very fine sand to very coarse gravel	15	35
Sand, gravelly; very fine sand to fine gravel, some medium gravel	35	41.8
Tertiary System:		
Pliocene Series-		
Ogallala Formation		
Silt, very clayey, slightly sandy, pinkish-gray; sand is very fine	41.8	43
Silty sand to sandy silt, slightly clayey, brown; sand is very fine to fine, some medium; trace of volcanic ash	43	45.5
Sand, very fine to coarse, some very coarse; very fine to medium, some coarse, trace of very coarse from 50 to 55 ft	45.5	59
Silty sand to sandy silt, slightly clayey, brown; sand is very fine to fine, little medium; some coarser grains below 60 ft	59	65
Sand, gravelly; very fine sand to fine gravel, some medium to coarse gravel	65	80
Gravel, sandy; very fine sand to fine gravel, some medium to coarse gravel	80	100
Sand, gravelly; very fine sand to medium gravel, some coarse gravel; some interbedded silt lenses from 100 to 110 ft; very fine sand to fine gravel with some gravel below 105 ft	100	115
Sand, very fine to coarse, some very coarse; trace of gravel below 120 ft	115	126.5
Silty sand to sandy silt, slightly clayey, light-brown; sand is very fine	126.5	130

	Depth, in Feet	
	From	To
14N-53W-3aaa--continued		
Tertiary-Pliocene-Ogallala--continued		
Silt, slightly clayey, slightly sandy, light-brown; sand is very fine to fine	130	132
Sand, slightly gravelly; very fine sand to fine gravel, much coarse to very coarse sand; some silt below 155 ft	132	160
Silt, slightly clayey, slightly sandy, light olive-gray to light-brown; sand is very fine to fine	160	161
Silty sand to sandy silt, slightly clayey, pale-brown; sand is very fine to fine	161	165
Sandstone, very fine- to fine-grained, light-brown, moderately consolidated; sand is very fine to coarse from 170 to 175 ft; sand is very fine to medium with some coarse below 175 ft	165	185
Sandstone, very fine- to fine-grained, silty, light-brown, poorly consolidated	185	192
Silt to siltstone, slightly clayey, light-brown, some pink, limy areas	192	200
Silty sand to sandy silt, slightly clayey, light-brown; sand is very fine to fine; limy areas	200	205
Sandstone, very fine- to fine-grained, light-brown, slightly silty, moderately consolidated, in part marly	205	220
Sandy silt, slightly clayey, pale-brown, slightly calcareous, some limy areas; sand is very fine to fine; light-gray below 225 ft	220	227.5
Sandstone, very fine- to fine-grained, in part silty, brown, moderately calcareous, poorly consolidated	227.5	231.5
Sand and gravel; fine sand to medium gravel, principally limestone fragments; less medium gravel below 235 ft	231.5	240
Sandstone, fine- to medium-grained, some coarse sand and a trace of fine gravel, moderately consolidated	240	244.3
Sandstone, gravelly; sand is very fine to fine; gravel principally limestone fragments	244.3	245
Tertiary System:		
Oligocene Series (White River Group)-undifferentiated		
Sandstone,silty to silt,sandy, very fine- to fine-grained, light yellowish-brown	245	246.5
Silt to siltstone, slightly clayey, pale-olive; light yellowish-brown below 255 ft; interbedded sandstone from 255.6 to 256.8 ft	246.5	260

	Depth, in Feet	
	From	To
14N-53W-3aaa--continued		
Tertiary-Oligocene--continued		
Silt to siltstone, slightly clayey, slightly sandy; in part, very sandy; pale-yellow; sand is very fine; pale-olive from 265 to 275 ft; marly from 270 to 271.5 ft ----------	260	277.7
Silt to siltstone, slightly clayey, slightly sandy, light-green; sand is very fine; some limonitic grains; light bluish-gray and green below 285 ft; interbedded sandstone lenses below 289.5 ft ----------	277.7	291
Silt to siltstone, slightly clayey, blue; marly areas from 293 to 295 ft ----------	291	300

Test Hole 14N-53W-20aaa
(Field No. 2-ANB-70)

Location: 89 ft south and 197 ft west of NE cor. sec. 20, T. 14 N., R. 53 W.
Ground altitude: 4,658 ft (a)
Depth to water: 217.6 ft (Oct. 17, 1970)

	Depth, in Feet	
	From	To
Quaternary System-undifferentiated		
Silt, slightly clayey, dark grayish-brown -----	0	1
Tertiary System:		
Pliocene Series-		
Ogallala Formation		
Sandstone, very fine- to very coarse-grained, rare gravel grains, white, very calcareous, moderately consolidated; few rootlets below 5 ft ----------	1	20
Sandstone, very fine- to medium-grained, with rare coarse to very coarse grains, moderately silty, moderately calcareous, brown, well consolidated; interbedded limestone lenses below 25 ft ----------	20	35
Sandstone, very fine- to coarse-grained, some very coarse, moderately silty, light-brown and pinkish-white, very calcareous, well consolidated; interbedded limestone lenses ----------	35	40
Limestone, sandy, white; sand is very fine to medium, little coarse to very coarse, rare gravel grains ----------	40	45
Sandstone, very fine- to fine-grained, slightly silty, brown, well consolidated; interbedded limestone lenses and coarser-grained below 50 ft ----------	45	55
Limestone, sandy, pinkish-gray; sand is very fine to coarse with a trace of fine gravel --	55	60

	Depth, in Feet	
	From	To
14N-53W-20aaa--continued		
Tertiary-Pliocene-Ogallala--continued		
Sandstone, very fine- to very coarse-grained, moderately silty, light-brown and pinkish-gray, very calcareous, well consolidated ----	60	65
Sand, gravelly; very fine sand to fine gravel, trace of medium gravel; interbedded siltstone lens ----------	65	75
Gravel, sandy; very fine sand to fine gravel, some medium and a trace of coarse gravel ----	75	80
Sand, gravelly; very fine sand to fine gravel, some medium gravel ----------	80	85
Sandstone, very fine- to fine-grained, little medium to coarse, moderately silty, pinkish-gray, very calcareous, well consolidated; some limy lenses below 90 ft ----------	85	95
Sandstone, very fine- to coarse-grained, moderately silty, pinkish-gray; brown color and finer-grained below 100 ft --------	95	120
Silt to siltstone, slightly clayey, brown; some interbedded silty sandstone ----------	120	139.5
Sand, gravelly; very fine sand to fine gravel, some medium, trace of coarse gravel, in part clayey ----------	139.5	145
Sand, gravelly; very fine sand to fine gravel, some medium gravel ----------	145	150
Gravel, sandy; very fine sand to fine gravel, some medium to coarse gravel ----------	150	155
Sand, gravelly; very fine sand to fine gravel, some medium, a trace of coarse gravel -------	155	165
Gravel, sandy; very fine sand to medium gravel, a little coarse gravel ----------	165	170
Sand, gravelly; very fine sand to fine gravel; some medium gravel to 175 ft ----------	170	180
Sand, gravelly; very fine sand to fine gravel, a little medium gravel with a trace of coarse to very coarse gravel ----------	180	190
Sand, very fine to very coarse, little to fine gravel; interbedded sandstone and siltstone lenses ----------	190	195
Limestone, sandy, light-gray to light-brown; sand is very fine to fine; interbedded siltstone lenses ----------	195	200
Sandstone, very fine- to fine-grained, moderately silty, light-gray to light brownish-gray, very calcareous, well consolidated; interbedded limy areas ----------	200	205
Limestone, sandy, gray; sand is very fine to fine ----------	205	210
Sandstone, very fine- to fine-grained, moderately silty, grayish-brown, moderately		

	Depth, in Feet	
	From	To
14N-53W-20aaa--continued		
Tertiary-Pliocene-Ogallala--continued		
calcareous, poorly consolidated; interbedded silt lenses from 215 to 220 ft	210	230
Silt, slightly clayey, slightly sandy, pale-brown to light yellow-brown, very calcareous; sand is very fine; limy areas and interbedded sandstone lenses	230	250
Silt, slightly clayey, in part moderately sandy, brown, very calcareous; sand is very fine to fine; limy areas and interbedded sandstone lenses	250	260
Silt, moderately clayey, moderately sandy, light yellow-brown, very calcareous; sand is very fine; limy areas; interbedded sandstone lenses; some very coarse sand to fine gravel from 262 to 266 ft	260	275
Silt, moderately sandy, slightly clayey, pale-brown, very calcareous; sand is very fine to fine	275	280
Silt, moderately clayey, light-gray, moderately calcareous; limy areas; interbedded sandstone lenses	280	285
Silt, moderately clayey, brown, moderately calcareous, limy areas; moderately sandy below 290 ft; sand is very fine	285	300
Silt, moderately clayey, slightly sandy, light yellow-brown, moderately calcareous; sand is very fine; some limy areas; some light-brown from 305 to 310 ft; brown below 315 ft	300	319
Tertiary System:		
Oligocene Series (White River Group)-		
Brule Formation		
Silt to siltstone, moderately clayey, strong brown, moderately calcareous	319	320
Siltstone, slightly clayey, yellowish to red	320	325
Siltstone, slightly clayey, light-brown, moderately calcareous	325	335
Siltstone, slightly clayey, light brown and yellowish to red	335	340

Test Hole 14N-53W-34ddd
(Field No. 32-B-69)

Location: 36 ft north and 90 ft west of SE cor. sec. 34, T. 14 N., R. 53 W.
Ground altitude: 4,361 ft (a)
Depth to water unknown: Test Hole caved at 179 ft (Sept. 2, 1969)

	Depth, in Feet	
	From	To
Quaternary System-undifferentiated		
Silt, very sandy, slightly clayey, dark-brown, moderately calcareous; sand is very fine to fine with some medium to coarse	0	0.9
Tertiary System:		
Pliocene Series-		
Ogallala Formation		
Sandstone, very fine- to medium-grained, moderately silty, pinkish-white and brown; moderately calcareous to 3 ft; poorly consolidated; trace of coarse sand to fine gravel below 5 ft, some rootlets	0.9	6.5
Sandstone, very fine- to medium-grained with some coarse sand to medium gravel, moderately silty, pinkish-gray and brown; some limy areas; some rootlets	6.5	17
Marl, sandy, white	17	19.7
Sandstone, very fine- to fine-grained with some medium sand to coarse gravel, moderately silty, brown, well consolidated	19.7	20
Sandstone, very fine- to medium-grained with some coarse sand to fine gravel, moderately silty, pinkish-gray; some limy areas; rootlets below 25 ft	20	25.5
Gravel, sandy; coarse sand to coarse gravel	25.5	29
Sand, very fine to fine with some medium to coarse; some fine to coarse gravel	29	31
Sandstone, very fine- to fine-grained, some medium sand to fine gravel, brown, slightly calcareous, moderately consolidated; in part silty and marly	31	44
Sand, very fine to fine with some medium sand to fine gravel	44	48
Sand, slightly gravelly; medium sand to coarse gravel, much coarse sand to fine gravel	48	52.5
Siltstone, slightly clayey, sandy, pinkish-gray, slightly calcareous; sand is very fine to fine	52.5	53.5
Silty sand to sandy silt, slightly clayey, light-brown; sand is very fine to fine with some medium sand to fine gravel	53.5	55
Sand, very fine to coarse, slightly silty; very fine to medium from 57 to 64 ft	55	75
Sand, very fine to coarse; trace of fine gravel below 80 ft	75	85

	Depth, in Feet From	To
14N-53W-34ddd--continued		
Tertiary-Pliocene-Ogallala--continued		
Sand, slightly gravelly; very fine sand to fine gravel with some medium to coarse gravel	85	90
Sand, very fine to very coarse with a little fine gravel	90	113.5
Silt, very sandy, moderately clayey, light reddish-brown and light-brown; slightly calcareous to 128.5 ft; sand is very fine to fine; some marly areas	113.5	135
Silty sand to sandy silt, slightly clayey, brown; sand is very fine to fine; some medium to coarse sand below 139 ft	135	143.5
Sand, very fine to coarse, some very coarse sand	143.5	145
Sand, slightly gravelly; very fine sand to fine gravel; less gravel below 155 ft	145	159
Silt, moderately sandy, slightly clayey, light-brown; sand is very fine to fine with a trace of medium	159	163.5
Silty sand to sandy silt, slightly clayey, light-brown; sand is very fine to fine with some medium	163.5	170
Silt, moderately clayey, moderately sandy, light-brown; sand is very fine	170	174
Sand, very fine to very coarse with a little fine gravel	174	180
Sand, gravelly; very fine sand to fine gravel with a trace of medium to coarse gravel	180	191.5
Silt, moderately sandy, slightly clayey, pinkish-gray, brown and light-gray; sand is very fine to fine; marly areas below 199 ft	191.5	201.5
Marl, sandy, light-gray; sand is very fine to fine	201.5	202
Silt, moderately sandy, slightly clayey, light brownish-gray, moderately calcareous; sand is very fine to fine	202	208
Sand, very fine to very coarse with a trace of fine gravel, much coarse sand; silt lens from 222.6 to 223 ft	208	230
Sand, slightly gravelly; very fine sand to fine gravel, much very coarse sand	230	240
Sand, very fine to very coarse with a trace of fine gravel, much very coarse sand	240	250
Sand, very fine to very coarse with a little fine gravel	250	260
Sand, gravelly; very fine sand to fine gravel, little medium gravel	260	268
Silty sand to sandy silt, slightly clayey, pinkish-gray; sand is very fine to medium, some coarse	268	270

	Depth, in Feet	
	From	To
14N-53W-34ddd--continued		
Tertiary-Pliocene-Ogallala--continued		
Silt, moderately sandy, slightly clayey, pale-brown; sand is very fine to fine	270	279.8
Silty sand to sandy silt, slightly clayey, pale-brown; sand is very fine to fine	279.8	282
Sand, very fine to very coarse with a trace of fine gravel, much coarse sand; thin silt lens about 285 ft and 290 ft	282	291.5
Sand, slightly gravelly; very fine sand to fine gravel, much coarse sand	291.5	299
Silt to siltstone, moderately clayey, light-brown, moderately calcareous	299	310
Silty sand to sandy silt, slightly clayey, pinkish-gray; sand is very fine to coarse; some marly areas	310	315
Sand, very fine to fine with a trace of medium, very silty; very fine to medium with some coarse below 317 ft	315	318.8
Sand, slightly gravelly; very fine sand to fine gravel, silty, principally limestone gravel	318.8	321.5
Sand, slightly gravelly; very fine sand to fine gravel, principally siltstone, lime-stone, and sandstone fragments	321.5	325
Silty sand to sandy silt, marly, light-brown; sand is very fine to fine	325	328.5
Sand and gravel; very fine sand to fine gravel with a trace of medium to coarse gravel, principally limestone fragments; in part marly below 330 ft	328.5	335
Silty sand to sandy silt, slightly clayey, light-brown; sand is very fine to very coarse with a trace of gravel; very fine to fine sand below 336.5 ft	335	340.5
Sand, gravelly; fine sand to fine gravel with some medium to coarse gravel, many limestone fragments	340.5	344
Tertiary System:		
Oligocene Series (White River Group)-		
Brule Formation		
Siltstone, slightly clayey, slightly sandy, light-brown, moderately calcareous; sand is very fine	344	350
Silt to siltstone, slightly clayey, light-brown, moderately calcareous; in part some very fine sand	350	390

Test Hole 14N-54W-1aaa
(Field No. 28-B-69)

Location: 103 ft south and 172 ft west of NE cor. sec. 2, T. 14 N., R. 54 W.
Ground altitude: 4,569 ft (a)
Depth to water: 113.9 ft (Sept. 1, 1969)

	Depth, in Feet	
	From	To
Tertiary System:		
Pliocene Series-		
Ogallala Formation		
Sandstone, very fine- to very coarse-grained, slightly silty, brown, poorly consolidated; some gravel grains to 3 ft; some rootlets from 3 to 4 ft; some pinkish-white color and limy areas below 4 ft	0	7
Sand, gravelly; fine sand to coarse gravel, in part some very coarse gravel	7	24.5
Silt, slightly clayey, brown	24.5	28
Sandstone, very fine- to fine-grained, some medium to coarse, brown, moderately consolidated	28	30
Sand, very fine to very coarse, slightly silty	30	31
Sand, slightly gravelly; fine sand to medium gravel, slightly silty; fine sand to coarse gravel below 32.5 ft	31	40
Silty sand to sandy silt, slightly clayey, light-brown; sand is very fine to fine	40	42.5
Silt, slightly clayey, slightly sandy, light-brown; sand is very fine to coarse; sand is very fine below 47 ft	42.5	51
Sand, very fine, moderately silty	51	53.3
Sand, gravelly; very fine sand to coarse gravel	53.3	69.3
Silt, moderately sandy, slightly clayey, light-brown; sand is very fine to medium; light reddish-brown below 71.5 ft	69.3	74.3
Silty sand to sandy silt, moderately clayey, light reddish-brown; sand is very fine to very coarse with a trace of fine gravel	74.3	77
Sand, slightly gravelly; very fine sand to fine gravel	77	77.3
Silt, slightly clayey, reddish-brown	77.3	80
Sand, very fine to very coarse with a trace of fine gravel, moderately silty	80	87
Sand, slightly gravelly; very fine sand to medium gravel, slightly silty	87	88.5
Silty sand to sandy silt, slightly clayey, pinkish-gray, some light-brown; sand is very fine to coarse	88.5	93.5
Sand, gravelly; fine sand to coarse gravel	93.5	97.8

	Depth, in Feet	
	From	To
14N-54W-1aaa--continued		
Tertiary-Pliocene-Ogallala--continued		
Silt, moderately clayey, moderately sandy, light reddish-brown; sand is very fine to very coarse	97.8	102
Sand, gravelly; very fine sand to coarse gravel; interbedded silt lenses to 105 ft	102	108.5
Silt, moderately sandy, slightly clayey, brown; sand is very fine to coarse	108.5	115
Silty sand to sandy silt, slightly clayey, reddish-brown; sand is very fine to coarse	115	123
Sand, very fine to very coarse with a little fine gravel	123	130.6
Silt, moderately clayey, moderately sandy, light-brown; sand is fine to coarse	130.6	135
Silty sand to sandy silt, moderately clayey, light-brown; sand is very fine to very coarse	135	142.5
Sand, very fine to very coarse; no very coarse sand below 150 ft; interbedded sandy silts from 156.5 to 160 ft	142.5	176
Silt, moderately clayey, slightly sandy, pale-brown; sand is very fine to fine; bentonitic below 182 ft	176	185
Sand, very fine to coarse, slightly silty	185	191
Silt, moderately sandy, slightly clayey, light-brown; sand is very fine	191	195
Silty sand to sandy silt, slightly clayey, pinkish-gray; sand is very fine to medium with some coarser grains; light brownish-gray below 200 ft	195	205
Silt to siltstone, slightly clayey, pink and light-gray	205	208.5
Sand and gravel; very fine sand to fine gravel	208.5	210
Sand, gravelly; very fine sand to fine gravel	210	220
Gravel, sandy; very fine sand to coarse gravel	220	225
Sand, very fine to very coarse, silty	225	227
Silt, moderately sandy, slightly clayey, light-brown; sand is very fine to fine	227	240
Silty sand to sandy silt, slightly clayey, light-brown; sand is very fine to fine	240	248
Silt, very clayey, moderately sandy, light-brown; sand is very fine	248	250
Sand, very fine, slightly silty, in part marly; some consolidation below 259 ft; some rootlets below 275 ft; sand is very fine to fine from 297 ft to 325 ft	250	344.5
Limestone, silty, sandy, gravelly, light-gray	344.5	345

	Depth, in Feet From	To
14N-54W-1aaa--continued		
Tertiary-Pliocene-Ogallala--continued		
Sand, very fine to fine, with some gravel grains	345	349.5
Sand, very fine to fine, with some medium to coarse, slightly silty	349.5	350
Sandstone, very fine- to fine-grained, silty, olive-green, moderately consolidated	350	353.3
Silt, very sandy, light-gray; sand is very fine; marly below 353.8 ft; sand is very fine to fine	353.3	355
Sandstone, very fine- to fine-grained, in part some medium, light olive-gray, moderately consolidated; marly from 358.5 to 360 ft; silty and clayey below 360 ft	355	367.8
Sandstone, very fine- to medium-grained, light olive-gray, well consolidated; slightly silty, light-gray below 369 ft	367.8	374.4
Marl, very sandy, silty, light-green and olive-yellow; sand is very fine to medium with some gravel grains	374.4	375
Sand, very fine to medium, some coarse, slightly silty	375	375.5
Marl, silty, light-greenish-gray, some olive and white, some siltstone	375.5	378
Marl, very sandy, slightly silty, blue and bluish-white; sand is very fine to coarse	378	380
Sand, very fine to medium, very silty	380	382
Tertiary System:		
Oligocene Series (White River Group)-undifferentiated		
Siltstone, very clayey, medium greenish-gray; some marly areas	382	390

Test Hole 14N-54W-6bbb
(Field No. 23-B-69)

Location: 95 ft south and 202 ft east of NW cor. sec. 6, T. 14 N., R. 54 W.
Ground altitude: 4,732 ft (a)
Depth to water unknown; Test Hole caved at 155 ft (Sept. 1, 1969)

	Depth, in Feet From	To
Quaternary-undifferentiated		
Silt, moderately sandy, slightly clayey, dark-brown; sand is very fine to medium	0	1
Tertiary System:		
Pliocene Series-		
Ogallala Formation		
Sand, very fine to medium, slightly silty, slightly clayey, in part lime-cemented; some interbedded siltstone below 5 ft	1	14.5

	Depth, in Feet	
	From	To
14N-54W-6bbb--continued		
Tertiary-Pliocene-Ogallala--continued		
Silt, slightly clayey, slightly sandy, reddish-brown, slightly calcareous; sand is very fine; pinkish-gray and light-brown below 15 ft	14.5	17
Sand, very fine to fine, slightly silty; in part sandy silt from 19.5 to 22 ft	17	23.5
Sand, gravelly; very fine sand to fine gravel, slightly silty; very fine sand to medium gravel below 25 ft	23.5	30
Gravel, sandy; very fine sand to medium gravel, much coarse sand to medium gravel	30	35
Silt, slightly clayey, slightly sandy, brown; sand is very fine; yellowish-red from 37.7 to 39 ft; very sandy, reddish-brown below 39 ft; sand is very fine to coarse	35	40
Silty sand to sandy silt, slightly clayey, reddish-brown; sand is very fine to fine	40	45
Silt, slightly clayey, slightly sandy, reddish-brown; sand is very fine to fine	45	49
Sand, very fine to medium with a trace of coarse, slightly silty	49	52
Sandstone, very fine- to fine-grained, brown, marly, very calcareous, well-consolidated; sand is very fine to medium below 58.3 ft	52	60.5
Silty sand to sandy silt, slightly clayey, pale-brown; some marly areas	60.5	68
Sand, gravelly; very fine sand to fine gravel	68	71.5
Silt, moderately sandy, slightly clayey, yellowish-brown; sand is very fine to fine	71.5	74.5
Sand, slightly gravelly; fine sand to fine gravel	74.5	75
Sand, very fine to fine, moderately silty; marly from 78.3 to 80 ft	75	80.5
Silt to siltstone, slightly clayey, slightly sandy, brown; sand is very fine	80.5	90
Silty sand to sandy silt, slightly clayey, brown; sand is very fine to fine with some coarser grains below 92 ft	90	97.2
Sand, slightly gravelly; fine sand to medium gravel, much fine to very coarse sand	97.2	103.5
Silt, moderately sandy, slightly clayey, brown	103.5	107
Sand, slightly gravelly; very fine sand to fine gravel	107	120
Sand, gravelly; very fine sand to coarse gravel; clay lens about 129.5 ft	120	130
Silt, slightly clayey, grayish-brown	130	131.3
Sand, very fine to coarse; very fine to fine and marly below 133.8 ft	131.3	134

	Depth, in Feet	
	From	To
14N-54W-6bbb--continued		
Tertiary-Pliocene-Ogallala--continued		
Silt, slightly clayey, slightly sandy, brown and pinkish-gray; sand is very fine to fine	134	143
Sand, very fine to coarse, slightly silty; very fine to very coarse below 153 ft	143	161.5
Silty sand to sandy silt, slightly clayey, pinkish-gray, moderately calcareous; sand is very fine to medium	161.5	162
Marl, sandy, pinkish-white; sand is very fine to medium	162	164.2
Silt, moderately sandy, slightly clayey, brown; sand is very fine to fine; some marly areas	164.2	166
Sand, very fine to fine, moderately silty; marly areas	166	180
Silt, moderately sandy, slightly clayey, light reddish-brown; sand is very fine	180	183.5
Silty sand to sandy silt, slightly clayey, brown; sand is very fine to fine; pinkish-gray from 185 to 188.1 ft; in part cemented	183.5	190
Sand, very fine to fine, slightly silty, some rootlets; in part cemented	190	208.8
Sand, very fine to fine, slightly silty; marly areas below 215 ft; in part cemented	208.8	220
Sandstone, very fine- to fine-grained, light-gray, very calcareous, well consolidated; in part marly	220	227
Sand, very fine to fine, slightly silty	227	240.9
Marl, sandy, white; sand is very fine	240.9	242
Sand, very fine, moderately silty; in part sandy silt; marly below 245 ft	242	246.9
Silty sand to sandy silt, slightly clayey, pale-brown; sand is very fine; some marly areas	246.9	259.5
Sand, very fine to fine, marly; in part cemented	259.5	272.3
Marl, sandy, silty, pale-brown and light-gray; sand is very fine to fine	272.3	276
Sand, very fine to fine, moderately silty	276	280
Silty sand to sandy silt, slightly clayey, marly, pale-brown; sand is very fine to medium	280	285
Silt to siltstone, slightly clayey, light yellowish-brown; pink below 286 ft	285	287.8
Marl, clayey, pinkish-white	287.8	288
Silt to siltstone, slightly clayey, light-brown and light-gray	288	293
Sand, very fine to medium	293	296.5
Silt to siltstone, slightly clayey, slightly sandy, pale-brown; sand is very fine	296.5	297.5

	Depth, in Feet	
	From	To
14N-54W-6bbb--continued		
Tertiary-Pliocene-Ogallala--continued		
Marl, silty, slightly clayey, pale-brown and light-gray; sandy below 300 ft; sand is very fine to medium	297.5	305
Silty sand to sandy silt, slightly clayey, pale-brown; sand is very fine to fine; in part marly	305	306.5
Marl, sandy, light-gray; in part cemented	306.5	307.1
Silt, moderately sandy, slightly clayey, pale-brown; sand is very fine; marly below 312 ft	307.1	312.5
Sand, very fine to medium, silty; marly areas; in part cemented	312.5	315.5
Silt, moderately clayey, sandy to gravelly	315.5	317
Silt to siltstone, slightly clayey, slightly sandy, pale-brown and light-gray; marly areas	317	320
Sand, gravelly; very fine sand to fine gravel; in part marly	320	330
Marl, sandy, slightly gravelly, light-gray; sand is very fine to very coarse	330	334
Sand, very fine to coarse, marly	334	337
Sand, slightly gravelly; very fine sand to fine gravel, much very fine to very coarse sand; marly areas; in part cemented	337	348
Sand, very fine to coarse, marly, silty	348	356.5
Silt, slightly clayey, light yellowish-brown	356.5	357
Marl, silty, sandy, slightly gravelly, light-gray; in part cemented	357	369
Sandy silt to silty sand, slightly clayey, pale-brown; sand is very fine	369	370
Silt, very sandy, slightly clayey, pale-brown; sand is very fine; marly below 371.5 ft	370	379
Sand, very fine to fine, moderately silty	379	384
Marl, moderately sandy, silty, light-gray	384	387.5
Sand, very fine to fine, marly	387.5	389
Tertiary System:		
Oligocene Series (White River Group)-		
Brule Formation		
Silt to siltstone, moderately sandy, slightly clayey, pale-brown; sand is very fine to fine	389	410

Test Hole 14N-54W-22bbb
(Field No. 6-ANB-70)

Location: 68 ft south and 6 ft east of NW cor. sec. 22, T. 14 N., R. 54 W.
Ground altitude: 4,712 ft (a)
Depth to water: 201.5 ft (Oct. 17, 1970)

	Depth, in Feet	
	From	To
Quaternary System-undifferentiated		
Silt, moderately sandy, slightly clayey, dark grayish-brown; sand is very fine to fine	0	2
Tertiary System:		
Pliocene Series-		
Ogallala Formation		
Sandstone, slightly gravelly; very fine sand to fine gravel	2	10
Sandstone, very fine- to very coarse-grained, moderately silty, brown, moderately calcareous; interbedded limestone and siltstone lenses; some rootlets below 15 ft	10	20
Sand, very fine to very coarse, trace of fine to medium gravel; interbedded siltstone lenses from 50 to 55 ft	20	67
Sandstone, very fine-grained, moderately silty, brown, well consolidated	67	73
Sand, very fine to very coarse, a little fine gravel	73	75
Sand, slightly gravelly; very fine sand to fine gravel, a little medium to coarse gravel	75	80
Sand, very fine to very coarse, a little fine to medium gravel; interbedded siltstone lenses to 85 ft	80	90
Sand, slightly gravelly; very fine sand to fine gravel, a trace of medium gravel	90	100
Sand, gravelly; very fine sand to fine gravel, a trace of medium gravel	100	106
Siltstone, very sandy, moderately clayey, brown; sand is very fine	106	120
Sand, very fine to very coarse, a little fine to medium gravel	120	125
Sand, slightly gravelly; very fine sand to medium gravel; clayey below 130 ft	125	134
Limestone, sandy, pinkish-gray; sand is very fine to fine, some medium sand	134	140
Limestone, sandy, silty, pinkish-gray and brown; sand is very fine to fine	140	145
Sand to sandstone, very fine to very coarse, pinkish-gray and brown; interbedded silty clay lenses	145	150

	Depth, in Feet	
	From	To
14N-54W-22bbb--continued		
Tertiary-Pliocene-Ogallala--continued		
Silt to siltstone, moderately sandy, moderately clayey, brown; sand is very fine to coarse, little very coarse	150	155
Silt, moderately clayey, moderately sandy, light reddish-brown; sand is very fine to coarse	155	165
Sand, very fine to very coarse, trace of fine gravel, moderately silty; less silt below 170 ft	165	175
Sand, very fine to coarse, a little very coarse sand, a trace of fine gravel; very fine to very coarse with a trace of fine gravel below 180 ft	175	185
Sand, slightly gravelly; very fine sand to fine gravel, a trace of medium gravel	185	195
Sand, very fine to very coarse, a trace of fine gravel; no gravel from 200 to 205 ft	195	216
Sandstone, very fine- to fine-grained, moderately silty, light-gray, well consolidated; interbedded silt lenses	216	220
Siltstone, moderately clayey, brown, moderately calcareous; in part lime-cemented sandstone	220	230
Siltstone, moderately clayey, brown, slightly calcareous, a little very fine sand	230	265
Sandstone to siltstone, very fine- to medium-grained, brown, some limy grains, some rounded sandstone grains; sand is very fine to fine below 270 ft; interbedded limy lens below 280 ft	265	286
Tertiary System:		
Oligocene Series (White River Group)-		
Brule Formation		
Silt to siltstone, moderately clayey, light-brown, moderately calcareous; light reddish-brown below 295 ft	286	300

Test Hole 14N-54W-36ddd
(Field No. 29-B-69)

Location: 502 ft west and 10 ft north of SE cor. sec. 36, T. 14 N., R. 54 W.
Ground altitude: 4,718 ft (a)
Depth to water: 258.7 ft (Sept. 2, 1969)

	Depth, in Feet	
	From	To
Quaternary System-undifferentiated		
Silty sand to sandy silt, slightly clayey, dark grayish-brown; sand is very fine to fine	0	2

	Depth, in Feet	
	From	To
14N-54W-36ddd--continued		
Tertiary System:		
Pliocene Series-		
Ogallala Formation		
Limestone, sandy, light-gray; sand is very fine to fine; some medium below 3 ft --------	2	4
Sandstone, very fine- to fine-grained, some very coarse, pale-brown, moderately calcareous, poorly consolidated; some fine to medium gravel below 7 ft --------	4	11.5
Sandstone, very fine- to fine-grained, some medium to coarse, light-brown and pinkish-white, moderately calcareous, moderately consolidated --------	11.5	12
Silty sand to sandy silt, slightly clayey, pink and light-brown; sand is very fine to medium; some coarse to very coarse below 16 ft; some marly areas --------	12	20
Sandstone, very fine- to very coarse-grained with a trace of gravel, slightly silty, light-brown, moderately calcareous, moderately consolidated --------	20	27.5
Limestone, marly, sandy, pinkish-white and brown; sand is in part sandstone, lime-cemented --------	27.5	33
Silty sand to sandy silt, slightly clayey, brown; sand is very fine to medium; in part marly; some interbedded sandstone lenses --------	33	42.5
Gravel, sandy; fine sand to fine gravel, much fine to medium sand, silty --------	42.5	49
Sandstone, very fine- to medium-grained, some coarse sand to fine gravel, light-brown, moderately consolidated --------	49	50
Silty sand to sandy silt, slightly clayey, brown and pinkish-gray; sand is very fine to medium; some marly areas --------	50	57.5
Sand, very fine to medium, silty --------	57.5	59
Marly sand, very fine to fine, silty, pinkish-white light-gray, sand is very fine to fine; some medium below 62 ft -------	59	66
Sand, very fine to medium, moderately silty ---	66	73
Sand, very fine to coarse, slightly silty, slightly clayey; very fine to medium below 74.5 ft --------	73	76
Sand, very fine to very coarse --------	76	80
Sand, gravelly; very fine sand to medium gravel --------	80	85.5
Silt to siltstone, slightly clayey, light reddish-brown --------	85.5	86.5

	Depth, in Feet	
	From	To
14N-54W-36ddd--continued		
Tertiary-Pliocene-Ogallala--continued		
Marl, silty, pale-brown to white; silt to silstone from 93 to 95 ft; pinkish-brown and brown below 95 ft	86.5	96
Silt, moderately clayey, slightly sandy, brown; sand is very fine to fine	96	100.9
Silty sand to sandy silt, light-brown and pinkish-gray; sand is very fine to fine, in part very fine to medium; some marly areas	100.9	122.5
Sand, gravelly; very fine sand to coarse gravel, much coarse sand and fine gravel; below 125 ft, very fine sand to fine gravel, much fine to medium sand	122.5	125.5
Marl, sandy, white	125.5	126
Silt, moderately sandy, slightly clayey, brown, some pinkish-gray; sand is very fine to medium; some marly areas	126	133.5
Sand, very fine to medium, moderately silty, some marly areas	133.5	139.5
Marl, sandy, silty, pinkish-gray; sand is very fine to medium	139.5	140
Silty sand to sandy silt, slightly clayey, pinkish-gray; sand is very fine to medium	140	141
Silt, moderately sandy, slightly clayey, brown to pinkish-gray; sand is very fine to medium	141	143
Sand, very fine to coarse, slightly silty, slightly clayey	143	147
Sand, gravelly; very fine sand to coarse gravel, much coarse sand to fine gravel	147	150
Sand, slightly gravelly; very fine sand to fine gravel, much medium to coarse sand	150	153
Silt, very sandy, slightly clayey, reddish-brown; sand is very fine; very clayey, slightly sandy, pale-yellow below 155 ft; sand is very fine to coarse	153	158
Silty sand to sandy silt, slightly clayey, brown, some pinkish-gray; sand is very fine to fine, some medium	158	180.2
Sand, gravelly; very fine sand to very coarse gravel, much medium to very coarse sand	180.2	190
Gravel, sandy; very fine sand to coarse gravel, some pebbles	190	220
Sand, gravelly; very fine sand to coarse gravel; some interbedded silt lenses below 230 ft	220	247.5
Silt, very clayey, pale-olive	247.5	250
Sand, gravelly; very fine sand to medium gravel	250	258.5

	Depth, in Feet From	To
14N-54W-36ddd--continued		
Tertiary System:		
Oligocene Series (White River Group)-		
Brule Formation		
Silt to siltstone, slightly clayey, brown; reddish-brown below 260 ft; slightly sandy, slightly calcareous below 265 ft; sand is very fine	258.5	274.5
Siltstone, slightly clayey, reddish-brown	274.5	280.5
Silt to siltstone, slightly clayey, light-brown, slightly calcareous	280.5	310

Test Hole 14N-55W-31ccc
(Field No. 19-B-69)

Location: 148 ft north and 48 ft east of SW cor. sec. 31, T. 14 N., R. 55 W.
Ground altitude: 4,868 ft (a)
Depth to water: 143.8 ft (July 28, 1969)

	Depth, in Feet From	To
Quaternary System-undifferentiated		
Sand, very fine, moderately silty	0	0.3
Tertiary System:		
Pliocene Series-		
Ogallala Formation		
Sandstone, very fine- to fine-grained, slightly silty, reddish-brown, poorly consolidated; some claystone fragments	0.3	3
Limestone, sandy, brown; sand is very fine to fine	3	6
Sandstone, very fine-grained, moderately silty, reddish-brown, yellowish-red, pinkish-gray, moderately consolidated; in part lime cemented	6	15
Sandstone, very fine- to very coarse-grained, much very fine to fine, pinkish-gray, very calcareous, poorly consolidated; trace of fine gravel below 25 ft	15	30
Sand, very fine to fine with a trace of medium, slightly silty; some medium to coarse sand below 35 ft	30	41.5
Silt, very sandy, slightly calcareous, pale-brown, slightly calcareous; sand is very fine to fine	41.5	43
Silty sand to sandy silt, brown; sand is very fine to medium; very fine to very coarse with a trace of gravel below 45 ft	43	50
Sand, slightly gravelly; medium sand to medium gravel, much medium to very coarse sand	50	59.7

	Depth, in Feet	
	From	To
14N-55W-31ccc--continued		
Tertiary-Pliocene-Ogallala--continued		
Silt to siltstone, brown; in part sandy below 61 ft	59.7	65
Gravel, sandy; coarse sand to medium gravel; silt lens about 73 ft	65	90
Sand, gravelly; very fine sand to medium gravel	90	92
Silt, slightly clayey, slightly sandy, brown; sand is very fine to medium; very sandy below 100 ft	92	103
Sand, gravelly; very fine sand to fine gravel, slightly silty	103	107
Silt, slightly clayey, moderately sandy, pale-brown; sand is very fine	107	110
Silty sand to sandy silt, light-gray, yellowish-brown, and brown; sand is very fine to medium with some coarser grains; some marly areas; some interbedded sandstone lenses	110	118.8
Sand, slightly gravelly; medium sand to fine gravel; some clayey sand lenses to 120 ft	118.8	125
Silt, moderately clayey, marly, sandy, light-brown; sand is very fine	125	129
Marl, very sandy, silty, pinkish-gray; sand is very fine to fine	129	139
Sand, slightly gravelly; very fine sand to coarse gravel, much very fine to coarse sand; marly areas below 145 ft	139	146.5
Silt, moderately sandy, slightly clayey, marly, brown; sand is very fine; coarser-grained below 147.5 ft	146.5	149.8
Tertiary System:		
Oligocene Series (White River Group)-		
Brule Formation		
Marl, slightly silty, sandy, pinkish-white; sand is very fine to fine	149.8	150.4
Silt, slightly clayey, slightly sandy, pinkish-brown, slightly calcareous; sand is very fine; some siltstone fragments	150.4	195
Silt, slightly clayey, slightly sandy, yellowish-red, slightly calcareous; sand is very fine	195	200

Test Hole 14N-56W-6bbb
(Field No. 13-B-69)

Location: 42 ft south and 1 ft east of NW cor. sec. 6, T. 14 N., R. 56 W.
Ground altitude: 4,773 ft (a)
Depth to water: 43.5 ft (July 8, 1969)

	Depth, in Feet	
	From	To
Quaternary System-undifferentiated		
No sample	0	2
Sand, very fine to medium, slightly clayey, slightly silty; very fine to coarse below 4 ft; gravelly below 5 ft	2	10
Tertiary System:		
Pliocene Series-		
Ogallala Formation		
Silt, moderately clayey, light-brown	10	14.5
Sand, very fine to medium, slightly silty; marly areas below 23.5 ft	14.5	28
Silty sand to sandy silt, slightly clayey, reddish-yellow; sand is very fine to fine	28	31.8
Sandstone, very fine- to fine-grained, slightly silty, pinkish-gray, moderately calcareous, poorly consolidated; marly areas	31.8	33.5
Sand, very fine to fine, slightly silty; interbedded limy layers	33.5	37.2
Silty sand to sandy silt, slightly clayey, reddish-yellow; sand is very fine	37.2	37.5
Silt, moderately clayey, slightly sandy, light-brown, slightly calcareous; marly areas	37.5	40
Sandstone, very fine- to medium-grained, pinkish-white, very calcareous, poorly consolidated; marly areas; brown below 41 ft	40	42
Sand, gravelly; fine sand to medium gravel, much coarse sand to fine gravel	42	47
Siltstone, slightly clayey, light-green; brown below 47.1 ft	47	50
Sandstone, very fine- to fine-grained, brown, well consolidated; some medium sand from 51 to 53.5 ft; marly from 53.5 to 55 ft	50	56.5
Silt, moderately clayey, marly, slightly sandy, light-gray, moderately calcareous	56.5	60
Sandstone, very fine- to fine-grained, slightly silty, brown, poorly consolidated	60	70
Gravel, sandy; fine sand to medium gravel	70	74.5
Sand, very fine, slightly silty	74.5	75
Silt, moderately clayey, light reddish-brown	75	80
Gravel, sandy; fine sand to coarse gravel, much coarse sand to coarse gravel	80	106

	Depth, in Feet	
	From	To
14N-56W-6bbb--continued		
Tertiary-Pliocene-Ogallala--continued		
Silt, slightly clayey, pale-yellow	106	122
Sand, very fine, moderately silty	122	125
Sand, very fine to coarse	125	134.2
Silt, slightly clayey, pale-green; light brownish-green from 135 to 137 ft; pale-olive below 137 ft	134.2	137.5
Sandstone, very fine-grained, silty, light yellowish-brown, poorly consolidated	137.5	140
Silt, moderately sandy, slightly clayey, light brownish-gray; sand is very fine	140	145
Sandstone, very fine- to fine-grained, slightly silty, light brownish-gray, poorly consolidated	145	155
Gravel, sandy; fine sand to very coarse gravel; interbedded marly layers	155	161.5
Sand, very fine to fine; interbedded siltstone below 170 ft	161.5	180
Gravel, sandy; coarse sand to coarse gravel	180	188.3
Tertiary System:		
Oligocene Series (White River Group)-		
Brule Formation		
Silt to siltstone, slightly clayey, pale-brown; light yellowish-brown from 190 to 193 ft; slightly calcareous	188.3	200
Sand, very fine to fine, moderately silty, moderately clayey	200	202
Silt, moderately clayey, light-brown and pink; moderately sandy below 205 ft, sand is very fine	202	210

Test Hole 14N-56W-22bbb
(Field No. 13-ANB-70)

Location: 102 ft south and 31 ft east of NW cor. sec. 22, T. 14 N., R. 56 W.
Ground altitude: 4,919 ft (a)
Depth to water: 122.3 ft (Oct. 17, 1970)

	Depth, in Feet	
	From	To
Quaternary System-undifferentiated		
Silt, slightly clayey, dark grayish-brown	0	3
Tertiary System:		
Pliocene Series-		
Ogallala Formation		
Sand, gravelly; very fine sand to fine gravel, little medium with a trace of coarse gravel; interbedded limestone lenses	3	10
Sandstone, slightly gravelly; very fine sand to fine gravel	10	15

	Depth, in Feet	
	From	To
14N-56W-22bbb--continued		
Tertiary-Pliocene-Ogallala--continued		
Sandstone, very fine- to very coarse-grained, slightly silty, pinkish-gray, poorly consolidated; interbedded silt lenses ----------	15	20
Sand, very fine to very coarse, with a little fine gravel and a trace of medium gravel ----------	20	25
Sand, gravelly; very fine sand to fine gravel, some medium, a trace of coarse to very coarse gravel ----------	25	30
Sandstone, very fine- to very coarse-grained, moderately silty, reddish-brown, moderately consolidated; interbedded siltstone lenses --	30	35
Sandstone, very fine- to fine-grained, a little medium to coarse, very silty, reddish-brown, well consolidated; interbedded limestone lenses below 40 ft; trace of medium sand to fine gravel below 45 ft; clay lens about 48 ft ----------	35	53
Siltstone, slightly clayey, brown ----------	53	55
Sandstone, very fine- to fine-grained, moderately silty, light-brown, moderately consolidated; interbedded limestone, siltstone and chert lenses ----------	55	65
Sandstone to siltstone, very fine- to fine-grained, very silty, light-brown, moderately consolidated; interbedded limestone lenses; more siltstone from 70 to 75 ft ----------	65	76
Sand, very fine to very coarse ----------	76	80
Sand, very fine to very coarse, a little gravel ----------	80	85
Sandstone to siltstone, very fine- to very coarse-grained, moderately silty, brown to reddish-brown, moderately consolidated; less very coarse sand below 95 ft ----------	85	102
Sand, gravelly; very fine sand to fine gravel with a trace of medium to coarse gravel; interbedded sandstone lenses ----------	102	113
Sandstone, very fine to fine, moderately silty, light-brown, well consolidated ----------	113	115
Limestone, sandy, pinkish-gray; sand is very fine to fine ----------	115	120
Gravel, sandy; principally limestone, very coarse sand to very coarse gravel; some pebbles below 125 ft ----------	120	132
Tertiary System:		
Oligocene Series (White River Group)-		
Brule Formation		
Siltstone, light-brown to light reddish-brown, in part slightly calcareous ----------	132	180

Test Hole 14N-57W-6abb
(Field No. 8-B-69)

Location: 51 ft south and 891 ft NE of NW cor. sec. 6, T. 14 N., R. 57 W.
Ground altitude: 4,885 ft (a)
Depth to water: 23.9 ft (July 7, 1969)

	Depth, in Feet	
	From	To
Quaternary System-undifferentiated		
No sample	0	1
Silt, slightly clayey, sandy to gravelly, brown, slightly calcareous	1	4
Tertiary System:		
Pliocene Series-		
Ogallala Formation		
Sand, slightly gravelly, moderately silty	4	6
Gravel, sandy; fine sand to very coarse gravel	6	7.8
Sandstone, very fine-grained, silty, grayish-brown and yellowish-brown, slightly calcareous, moderately consolidated	7.8	13
Gravel, sandy; very fine sand to very coarse gravel	13	15
Sandstone, very fine- to fine-grained, silty, pinkish-gray and brownish-gray; some siltstone lenses and marly areas below 20 ft; sand is very fine to medium from 23.3 to 25 ft	15	27.2
Silt to siltstone, clayey, sandy, pinkish-gray, slightly calcareous; sand is very fine	27.2	30
Silty sand to sandy silt, slightly clayey, pinkish-gray; sand is very fine to fine	30	36.5
Sand, very fine to fine, brown and pinkish-brown; sand is very fine to coarse below 40 ft	36.5	45
Gravel, principally sandstone, siltstone, fragments	45	46.2
Tertiary System:		
Oligocene Series (White River Group)-		
Brule Formation		
Silt, slightly clayey, pinkish-gray; light-brown below 50 ft; slightly calcareous to 46.3 ft and below 50 ft	46.2	52.2
Silt, slightly clayey, slightly sandy, pale-brown; light yellowish-brown below 60 ft; sand is very fine to fine	52.2	62
Silty sand to sandy silt, slightly clayey, pale-brown; sand is very fine to fine	62	65
Silt to siltstone, slightly clayey, light yellowish-brown, slightly calcareous	65	80
Silt to siltstone, slightly clayey, pale-brown, slightly calcareous	80	95

	Depth, in Feet	
	From	To
14N-57W-6abb--continued		
Tertiary-Pliocene-Ogallala--continued		
Silt to siltstone, slightly clayey, pinkish-gray, slightly calcareous	95	100
Silt to siltstone, slightly clayey, pale-brown	100	120

Test Hole 14N-57W-21aaa
(Field No. 12-ANB-70)

Location: 141 ft south and 55 ft west of NE cor. sec. 21, T. 14 N., R. 57 W.
Ground altitude: 5,099 ft (a)
Depth to water: 164.6 ft (Oct. 17, 1970)

	Depth, in Feet	
	From	To
Tertiary System:		
Pliocene Series-		
Ogallala Formation		
Limestone, sandy, pale-brown to pinkish-white; sand is very fine	0	10
Sandstone, very fine- to medium-grained, moderately silty, light reddish-brown, slightly calcareous, well consolidated	10	15
Sandstone, very fine- to very coarse-grained with a little fine gravel, moderately silty, light-brown, well consolidated; a trace of rootlets, interbedded limestone lenses; reddish-brown below 25 ft; sand is very fine to medium	15	30
Sandstone, very fine- to very coarse-grained, with a little fine gravel, pinkish-gray, well consolidated; trace of rootlets	30	42
Sandstone, very fine- to very coarse-grained, a little fine gravel, moderately silty, pink to gray, slightly calcareous, well consolidated; interbedded limestone lenses; clay lens below 58 ft	42	60
Sandstone, very fine- to very coarse-grained, trace of fine gravel, very silty, pink to gray, well consolidated; some chert and a trace of rootlets from 65 to 70 ft; sand is very fine to fine with some medium below 70 ft	60	72
Clay, silty, brown, interbedded limestone and siltstone lenses; sand is very fine to fine	72	80
Clay, silty to siltstone, light-brown, interbedded limestone lenses; some very fine to medium sand	80	90

	Depth, in Feet	
	From	To
14N-57W-21aaa--continued		
Tertiary-Pliocene-Ogallala--continued		
Sandstone, very fine- to medium-grained, moderately silty, brown, poorly consolidated; very fine to medium with a little coarse; moderately consolidated below 95 ft	90	102
Clay, silty, light reddish-brown, slightly calcareous	102	108
Sand, very fine to medium, some coarse to very coarse, moderately silty; very fine to very coarse with a little fine gravel below 110 ft	108	117
Clay, silty, moderately sandy, reddish-brown, slightly calcareous; sand is very fine to very coarse with a trace of fine gravel; interbedded siltstone and limestone lenses	117	125
Sandstone, very fine-grained, moderately silty, reddish-brown, well consolidated; some siltstone	125	130
Sandstone, very fine- to very coarse-grained, with little fine gravel, moderately silty, pinkish-gray; interbedded clay lens	130	135
Siltstone to sandstone, slightly clayey, pinkish-gray, moderately calcareous; sand is very fine to fine; light reddish-brown below 140 ft	135	145
Sandstone, very fine- to coarse-grained, some very coarse, slightly silty, light-brown, moderately calcareous, moderately consolidated; light-gray from 150 to 155 ft; a little fine gravel below 150 ft; trace of rootlets from 155 to 160 ft	145	165
Silt to siltstone, moderately clayey, reddish-brown; interbedded limestone lenses; limy areas below 170 ft	165	185
Sandstone, very fine-grained, moderately silty, brown, moderately calcareous	185	190
Siltstone to sandstone, slightly clayey, brown; sand is very fine; interbedded limestone lens below 195 ft	190	200
Sandstone, very fine-grained, moderately silty, brown, poorly consolidated; some siltstone to limestone to 205 ft; slightly silty below 205 ft	200	212
Silt to siltstone, slightly clayey, brown with pink tint, slightly calcareous; pinkish to gray, moderately calcareous below 215 ft	212	223
Sand, gravelly; very fine sand to fine gravel, much coarse sand, some limy areas	223	229

	Depth, in Feet	
	From	To
14N-57W-21aaa--continued		
Tertiary System:		
Oligocene Series (White River Group)-		
Brule Formation		
Siltstone, slightly clayey, pinkish-gray, moderately calcareous, some very fine sand; light-brown with pinkish-tint below 235 ft	229	260

Test Hole 14N-57W-36ddd
(Field No. 12-B-69)

Location: 82 ft north and 6 ft west of SE cor. sec. 36, T. 14 N., R. 57 W.
Ground altitude: 5,026 ft (a)
Depth to water: 106.6 ft (July 8, 1969)

	Depth, in Feet	
	From	To
Quaternary System-undifferentiated		
Silt, slightly clayey, slightly sandy, dark-brown; sand is very fine; brown below 2.0 ft	0	2.5
Tertiary System:		
Pliocene Series-		
Ogallala Formation		
Siltstone, sandy, pinkish-white and reddish-brown; sand is very fine to medium	2.5	5
Sandstone, very fine to coarse, slightly silty, brown, slightly calcareous, poorly consolidated	5	7.3
Silt, moderately clayey, brown and reddish-brown with pink below 11.0 ft, moderately calcareous	7.3	13.3
Sand, very fine to medium, slightly silty below 14.5 ft; marly areas below 15 ft	13.3	15.5
Silt, slightly clayey, brown, pinkish-brown and reddish-brown; some marly areas below 18 ft; sandy below 19.5 ft; sand is very fine to coarse	15.5	21.5
Sand, very fine to medium, moderately silty	21.5	22.9
Silt, moderately sandy, slightly clayey, yellowish-red and reddish-brown, slightly calcareous	22.9	25
Silty sand to sandy silt, reddish-brown, brown with some pink; sand is very fine to medium; some marly areas	25	39
Silt, moderately clayey, reddish-brown, some marly areas, in part sandy; sand is very fine	39	42

	Depth, in Feet	
	From	To
14N-57W-36ddd--continued		
Tertiary-Pliocene-Ogallala--continued		
Silty sand to sandy silt, yellowish-red, brown and pinkish-gray; sand is very fine to medium; marly areas below 43 ft	42	48.3
Gravel, principally claystone	48.3	50
Sand, very fine to fine, slightly silty	50	51.5
Silt to siltstone, slightly clayey, reddish-brown; sandy below 55 ft; sand is very fine to medium	51.5	60
Sandstone, very fine to medium-grained, slightly silty, pink, light-brown and pinkish-gray; some marly areas; trace of fine gravel below 63.5 ft	60	65
Sand and gravel; very fine sand to fine gravel; marly areas	65	72
Silty sand to sandy silt, brown; sand is very fine to coarse	72	74
Sand, gravelly, silty	74	77
Silt, slightly clayey, slightly sandy, reddish-brown; sand is very fine to fine	77	77.5
Silty sand to sandy silt, reddish-brown; sand is very fine to fine	77.5	80
Sand, very fine to medium	80	81
Silt, moderately clayey, marly, pink; sandy below 84.5 ft; sand is very fine to medium	81	85
Sand, very fine to medium, slightly silty; marly areas and interbedded sandstone lenses below 87.5 ft	85	114.5
Marl, sandy, silty, pinkish-white; sand is very fine to medium	114.5	118.5
Sand, very fine to fine, silty, marly, some sandstone	118.5	123.8
Marl, sandy, silty, pinkish-white; sand is very fine to medium	123.8	127.6
Tertiary System:		
Oligocene Series (White River Group)-		
Brule Formation		
Silt to siltstone, slightly clayey, sandy, light-brown; sand is very fine to fine	127.6	130
Silt, moderately clayey, slightly sandy, light-brown; sand is very fine	130	140
Silt, moderately clayey, slightly sandy, light yellowish-brown, light brown and light reddish-brown; moderately calcareous to 143 ft; slightly calcareous below 143 ft; sand is very fine	140	145.5
Silt, moderately clayey, slightly sandy, yellowish-red; sand is very fine; light yellowish-brown below 146 ft	145.5	180

Test Hole 14N-59W-1bbb
(Field No. 3'-B'-69)

Location: 16 ft south and 472 ft east of NW cor. sec. 1, T. 14 N., R. 59 W.
Ground altitude: 5,080 ft (Pine Bluff 7.5 minute quadrangle)
Depth to water: 84.7 ft (June 23, 1969)

	Depth, in Feet	
	From	To
Quaternary System-undifferentiated		
Silt, slightly clayey, very sandy, dark-brown, moderately calcareous; sand is very fine to fine	0	0.5
Tertiary System:		
Pliocene and Miocene Series-undifferentiated		
Sandstone, very fine- to fine-grained, silty, light-brown, slightly calcareous to 5 ft, poorly consolidated	0.5	10.5
Sandstone, very fine- to fine-grained, light-brown, moderately consolidated	10.5	20
Sandstone, very fine- to fine-grained, silty, pinkish-gray, moderately consolidated	20	25
Siltstone, clayey, sandy, light-brown; sand is very fine	25	50
Tertiary System:		
Oligocene Series (White River Group)-		
Brule Formation		
Siltstone, clayey, reddish-brown; sandy below 55 ft; sand is very fine	50	60
Siltstone, clayey, light-brown	60	70
Siltstone, clayey, light yellowish-brown with a little reddish-brown	70	89
Siltstone, clayey, light yellowish-brown; slightly sandy below 90 ft; sand is very fine	89	120

Test Hole 14N-59W-35aca
(Field No. 2-B-69)

Location: About 2,000 ft south and 2,050 ft west of NE cor. sec. 35, T. 14 N., R. 59 W.
Ground altitude: 5,298 ft (Pine Bluff 7.5 minute quadrangle)
Depth to water: 156.1 ft (June 23, 1969)

	Depth, in Feet	
	From	To
Quaternary System-undifferentiated		
Silt, slightly clayey, sandy, brown; sand is very fine to fine; limy below 3.3 ft	0	4.9
Tertiary System:		
Pliocene Series-		
Ogallala Formation		
Sand, very fine to medium, silty; very fine below 10 ft; limy fragments below 15 ft	4.9	18

	Depth, in Feet	
	From	To
14N-59W-35aca--continued		
Tertiary-Pliocene-Ogallala--continued		
Sand, gravelly; very fine sand to coarse gravel; some limy fragments	18	20
Sand, very fine to coarse, in part clayey	20	25
Sand, very fine to coarse; some gravel grains	25	30
Sand, gravelly; very fine sand to coarse gravel, in part lime-cemented	30	38.5
Limestone, marly, pinkish-gray to white	38.5	42.1
Sand, gravelly; very fine sand to coarse gravel, some consolidation	42.1	45.7
Silt, sandy, pinkish-gray, slightly calcareous; sand is very fine to fine	45.7	49
Sandstone, very fine- to fine-grained, reddish-yellow, poorly consolidated; some limy grains	49	49.2
Gravel, fine to medium; much limy material	49.2	52.4
Sandstone, very fine- to fine-grained, silty, pinkish-gray and light-brown, slightly calcareous, moderately consolidated; interbedded siltstone lens; limy grains; some gravel grains from 53.5 to 55 ft	52.4	66.4
Sand, very fine to medium, slightly clayey	66.4	71.3
Silt to siltstone, clayey, white, slightly calcareous	71.3	75
Sand, very fine to fine, silty, clayey, interbedded siltstone and limy lenses	75	87
Sandstone, very fine- to fine-grained, silty, yellowish-brown and pinkish-gray, slightly calcareous, poorly consolidated	87	90
Sand, very fine to medium, silty	90	101.5
Silt, slightly clayey, very sandy, light-brown, slightly calcareous; sand is very fine	101.5	106.5
Limestone, sandy, white; sand is very fine	106.5	112.8
Silt, moderately sandy, slightly clayey, pinkish-gray, slightly calcareous; sand is very fine	112.8	116
Sand, very fine to fine, silty; limy areas	116	123.8
Tertiary System		
Oligocene Series (White River Group)-		
Brule Formation		
Silt, moderately sandy, clayey, pinkish-gray, moderately calcareous; sand is very fine	123.8	125
Silt to siltstone, clayey, slightly sandy, light-gray, very calcareous; pinkish-gray below 127.5 ft	125	130
Silt to siltstone, clayey, light yellowish-brown	130	180

Test Hole 15N-53W-21bbb
(Field No. 3-ANB-70)

Location: 100 ft south and 61 ft east of NW cor. sec. 21, T. 15 N., R. 53 W.
Ground altitude: 4,640 ft (a)
Depth to water: 223.6 ft (Oct. 10, 1970)

	Depth, in Feet From	To
Quaternary System-undifferentiated		
Silt, moderately sandy, slightly clayey, light-brownish-gray; sand is very fine to medium, trace of coarse	0	1
Silty sand to sandy silt, slightly clayey, pale-brown; sand is very fine to very coarse; rare gravel	1	5
Silt, very sandy, slightly clayey, brown; sand is very fine to medium	5	10
Tertiary System:		
Pliocene Series-		
Ogallala Formation		
Sandstone, very fine- to fine-grained, little medium, trace of coarse, very silty, dark-red, well consolidated; moderately silty, coarser grained below 20 ft	10	25
Sand, very fine to very coarse; little fine gravel	25	30
Siltstone, slightly clayey, dark-brown; interbedded silty sandstone lenses	30	40
Sand, gravelly; very fine sand to fine gravel, trace of medium gravel	40	50
Sand, very fine to very coarse; trace of fine gravel; interbedded silt lenses	50	60
Sandstone, very fine- to very coarse-grained, moderately silty, pinkish-gray, very calcareous, well consolidated	60	65
Sandstone, very fine- to fine-grained, very silty, dark-brown, very calcareous, well consolidated	65	70
Clay, very silty, moderately sandy, pink, moderately calcareous; sand is very fine to fine	70	75
Sandstone, very fine- to fine-grained, slightly silty, pinkish-gray, very calcareous, well consolidated	75	80
Limestone, white	80	87
Sandstone, very fine- to fine-grained, moderately silty, brown, well-consolidated; interbedded silt lenses below 100 ft	87	104.5
Sand, very fine to very coarse, moderately silty; some rootlets	104.5	110
Sand, slightly gravelly; very fine sand to fine gravel; limestone lenses below 115 ft --	110	120

	Depth, in Feet	
	From	To
15N-53W-21bbb--continued		
Tertiary-Pliocene-Ogallala--continued		
Clay, slightly silty, brown, interbedded sandstone and limestone lenses	120	132
Sandstone, very fine- to fine-grained, moderately silty, brown, poorly consolidated	132	135
Silt to siltstone, slightly clayey, light-brown, moderately calcareous; interbedded silty sandstone; limy areas	135	140
Sandstone, very fine-grained, slightly silty, light-gray, moderately consolidated	140	145
Sand, very fine to coarse, little very coarse; interbedded limy lenses; rootlets	145	155
Sandstone, very fine- to fine-grained, some coarse to very coarse, moderately silty, brown, moderately consolidated; limy lenses	155	160
Sandstone, very fine- to very coarse-grained, moderately silty, pinkish-gray, very calcareous, moderately consolidated; rare gravel; some rootlets	160	165
Silt to siltstone, slightly clayey, reddish-brown	165	166
Sand, slightly gravelly; very fine sand to fine gravel; some limy lenses to 170 ft; a little medium with a trace of coarse gravel below 170 ft; clay lens below 178 ft	166	180
Sand, gravelly; very fine sand to fine gravel, a little medium gravel with rare coarse to very coarse gravel	180	202.5
Clay, slightly silty, pinkish-gray	202.5	205
Clay, moderately sandy, slightly silty, light-brown; sand is very fine to fine; limy areas from 210 to 215 ft	205	220
Sand, very fine to coarse; a little fine gravel to 225 ft	220	230
Sand, slightly gravelly; very fine sand to fine gravel	230	234
Clay, slightly silty, olive-gray	234	235
Silt, very sandy, slightly clayey, brown; sand is very fine to fine, some medium; limy areas	235	243
Sand, very fine to very coarse, with a little fine gravel; interbedded silt lens	243	245
Gravel, sandy; very fine sand to fine gravel, some medium gravel	245	251
Silt, moderately clayey, moderately sandy, light-brown, very calcareous; sand is very fine to fine, some medium	251	255
Silt, very clayey, in part slightly sandy, reddish-brown; sand is very fine to fine; limy areas	255	263

	Depth, in Feet	
	From	To
15N-53W-21bbb--continued		
Tertiary-Pliocene-Ogallala--continued		
Sand, very fine to very coarse	263	265
Silt, very sandy, slightly clayey, brown, some grayish-brown; sand is very fine to fine; interbedded lime-cemented sandstone lenses	265	275
Silt, moderately clayey, moderately sandy, brown; sand is very fine to fine; some limy areas	275	290
Silt, moderately clayey, moderately sandy, pinkish-gray, some brown; sand is very fine to fine	290	297
Sandstone, very fine- to fine-grained, moderately silty, pinkish-gray, very calcareous, well consolidated	297	303.5
Clay, very sandy, moderately silty, pinkish-gray and brown; sand is very fine to very coarse with some gravel grains; some bentonite	303.5	305
Silt, very clayey, moderately sandy, pinkish-gray and brown; sand is very fine to coarse, some very coarse; interbedded sandstone lenses	305	310
Sand, very fine to very coarse, in part very silty, light reddish-brown, moderately calcareous; some limy areas	310	314
Silt, moderately clayey, moderately sandy, pinkish-gray; sand is very fine to fine; interbedded sandstone lenses	314	318
Sand, gravelly; very fine sand to fine gravel, little medium gravel; trace of coarse gravel below 325 ft	318	330
Gravel, sandy; very fine sand to fine gravel, some medium to coarse with a trace of very coarse gravel; clay lens from 345 to 346 ft	330	350
Sand, slightly gravelly; very fine sand to fine gravel	350	360
Sand, very fine to medium, some coarse to very coarse, rare fine gravel	360	365
Sand, slightly gravelly; very fine sand to fine gravel; limestone lens from 366 to 368 ft	365	375
Sand, very fine to very coarse, in part lime-cemented	375	380
Sand, slightly gravelly; very fine sand to fine gravel, trace of medium gravel, in part lime-cemented; little medium gravel with trace of coarse gravel below 395 ft	380	395

15N-53W-21bbb--continued	Depth, in Feet From	To
Tertiary System:		
Oligocene Series (White River Group)-		
Brule Formation		
Silt, very clayey, slightly sandy, pinkish-gray, moderately calcareous	395	400
Silt to siltstone, slightly clayey, light-brown; brown with some yellowish-red from 405 to 410 ft; reddish-brown below 410 ft	400	415

Test Hole 15N-54W-1aaa
(Field No. 27-B-69)

Location: 564 ft south and 16.5 ft west of NE cor. sec. 1, T 15 N., R. 54 W.
Ground altitude: 4,632 ft (a)
Depth to water unknown; Test Hole caved at 185 ft (Sept. 1, 1969)

	Depth, in Feet From	To
Quaternary System-undifferentiated		
Silt, very sandy, slightly clayey, dark-brown; sand is very fine to fine; coarser textured below 2 ft	0	4
Tertiary System:		
Pliocene Series-		
Ogallala Formation		
Gravel, sandy; very fine sand to very coarse gravel, slightly silty	4	10
Sand, slightly gravelly; very fine sand to very coarse gravel, slightly silty	10	13
Limestone, sandy, brown; sand is very fine to very coarse	13	15
Sand, slightly gravelly; very fine sand to fine gravel, marly, some sandstone	15	20.5
Sandstone, very fine- to medium-grained, slightly silty, light-brown to pinkish-white, very calcareous, moderately consolidated; some marly areas; much very fine to fine below 22 ft	20.5	28
Silt, marly, light-brown and pinkish-white; trace of very fine sand; very sandy below 30 ft	28	32.5
Sandstone, very fine- to medium-grained, with some coarser grains, moderately silty, light-brown and pink, very calcareous, moderately consolidated; marly areas	32.5	36
Sand, very fine to fine, very silty, in part marly	36	50
Silt, very sandy, slightly clayey, brown to white, marly; sand is very fine	50	54

	Depth, in Feet	
	From	To
15N-54W-1aaa--continued		
Tertiary-Pliocene-Ogallala--continued		
Marl, very sandy, brown to white; sand is very fine to fine	54	56.5
Silt, very sandy, slightly clayey, dark-brown, slightly calcareous; sand is very fine to fine	56.5	58.5
Marl, very sandy, brown; sand is very fine to fine	58.5	59
Silt, very sandy, slightly clayey, brown to light-gray; sand is very fine to fine	59	60
Sand, very fine to fine, slightly silty	60	65
Silty sand to sandy silt, slightly clayey, brown, slightly calcareous; sand is very fine to fine; marly from 69.5 to 70 ft	65	72
Silt, slightly clayey, slightly sandy, brown, slightly calcareous to 76.5 ft; sand is very fine; some thin marl lenses	72	87.2
Silty sand to sandy silt, slightly clayey, yellowish-brown, some light-gray; moderately calcareous from 91 to 94.5 ft; sand is very fine to medium	87.2	95.8
Sand and gravel; fine sand to coarse gravel	95.8	99
Silty sand to sandy silt, slightly clayey, olive; sand is very fine	99	102.5
Sand and gravel; fine sand to fine gravel with a trace of medium to coarse gravel	102.5	105
Gravel, sandy; fine sand to medium gravel with some coarse gravel	105	125
Silt, very sandy, slightly clayey, olive-gray; sand is very fine to fine	125	131.8
Sand, very fine to fine, very silty; some very coarse sand to fine gravel below 135 ft-	131.8	135
Silt, very sandy, slightly clayey, olive-gray; some interbedded gravel grains	135	138
Sand, very fine to medium, slightly silty	138	140
Sand and gravel; very fine sand to coarse gravel; silty to 141 ft; medium sand to medium gravel below 145 ft	140	150
Silt, slightly clayey, slightly sandy, pale-yellow; sand is very fine; pale-olive below 160 ft	150	160.5
Sand and gravel; fine sand to medium gravel	160.5	162.8
Silt, very sandy, slightly clayey, brown; sand is very fine to fine; some gravel grains from 164 to 165.3 ft; some marly areas from 168 to 173 ft	162.8	176.8
Sandstone, very fine-grained, marly, light-gray, very calcareous, well consolidated	176.8	178.5
Sand and gravel; fine sand to fine gravel; some medium gravel from 185 to 190 ft	178.5	205

	Depth, in Feet From	To
15N-54W-1aaa--continued		
Tertiary-Pliocene-Ogallala--continued		
Gravel, sandy; medium sand to coarse gravel ---	205	209
Silty sand to sandy silt, slightly clayey, pale-brown, some light-gray, slightly calcareous; sand is very fine to fine; some interbedded sandstone lenses; marly area below 215 ft ----------	209	220
Silt, moderately sandy, moderately clayey, brown; olive below 203 ft; sand is very fine to fine ----------	220	240.3
Sand, slightly gravelly; medium sand to fine gravel; silt lens about 249.8 ft ----------	240.3	250
Sand and gravel; fine sand to coarse gravel ---	250	252.5
Silt, moderately clayey, light-brown ----------	252.5	254
Sand and gravel; fine sand to coarse gravel ---	254	255
Sand, very fine to very coarse with some fine gravel, slightly silty ----------	255	258
Silt, moderately clayey, brown ----------	258	261.5
Sand, slightly gravelly; very fine sand to fine gravel, moderately silty ----------	261.5	265
Silt, moderately sandy, slightly clayey, brown; sand is very fine to fine ----------	265	268
Sand, slightly gravelly; very fine sand to coarse gravel, slightly silty ----------	268	275
Sand, gravelly; very fine sand to coarse gravel, slightly silty ----------	275	280
Gravel, slightly sandy; very fine sand to coarse gravel, much coarse gravel ----------	280	294.8
Tertiary System		
Oligocene Series (White River Group)-		
Brule Formation		
Silt to siltstone, slightly clayey, pale-olive, slightly calcareous ----------	294.8	296
Silt to siltstone, slightly clayey, brown; light reddish-brown from 325 to 332 ft; slightly calcareous ----------	296	350

Test Hole 15N-54W-22bbb
(Field No. 5-ANB-70)

Location: 43 ft south and 78 ft east of NW cor. sec. 22, T. 15 N., R. 54 W.
Ground altitude: 4,629 ft (a)
Depth to water: 125.3 ft (Oct. 17, 1970)

	Depth, in Feet From	To
Quaternary System- undifferentiated		
Silt, slightly clayey, slightly sandy, dark brownish-gray ----------	0	2

	Depth, in Feet	
	From	To
15N-54W-22bbb--continued		
Tertiary System:		
Pliocene Series-		
Ogallala Formation		
Sand, gravelly; fine sand to fine gravel, a little medium, trace of coarse gravel -------	2	5
Sand and gravel; fine sand to very coarse gravel ----------	5	10
Limestone, sandy to gravelly; very fine sand to very coarse gravel ----------	10	15
Siltstone, slightly clayey, reddish-brown; interbedded silty sandstone lenses ----------	15	20
Clay, very silty, reddish-brown, sandy to gravelly, very fine sand to very coarse gravel ----------	20	25
Silt to siltstone, slightly clayey, light-brown, some fine to medium sand ----------	25	30
Sandstone, very fine- to fine-grained, very silty, light reddish-brown, moderately calcareous, moderately consolidated ---------	30	35
Clay, slightly silty, light reddish-brown -----	35	45
Clay, slightly silty, in part sandy, limy areas, reddish-yellow; sand is very fine to fine ----------	45	50
Clay, slightly silty, limy areas, brown -------	50	58
Sand, slightly gravelly; very fine sand to fine gravel, some medium gravel; some very coarse gravel below 65 ft ----------	58	65
Gravel, sandy; very fine sand to very coarse gravel; interbedded sandstone lenses from 70 to 75 ft; finer-grained below 75 ft ------	65	80
Sand, very fine to very coarse, interbedded clay and sandstone lenses ----------	80	85
Silt, moderately clayey, moderately sandy, light-brown, moderately calcareous; sand is very fine to fine; reddish-gray, non-calcareous below 95 ft ----------	85	102
Sand, very fine to very coarse, a little fine gravel ----------	102	115
Clay, slightly silty, light reddish-brown; some limy areas to 130 ft; light-brown below 140 ft ----------	115	144.5
Sand, very fine to very coarse, trace of fine gravel ----------	144.5	150
Sand, very fine to medium, slightly silty; interbedded clay lenses ----------	150	155
Clay, very sandy, slightly silty, pinkish-gray and light brownish-gray; sand is very fine to medium ----------	155	162.5
Sand, very fine to very coarse, a little fine gravel ----------	162.5	166

	Depth, in Feet	
	From	To
15N-54W-22bbb--continued		
Tertiary-Pliocene-Ogallala--continued		
Clay, slightly silty, in part sandy, brownish-gray and reddish-brown; sand is very fine to fine	166	170
Silt, very sandy, moderately clayey, light brownish-gray; sand is very fine to fine	170	175
Sand, very fine to medium, trace of coarse	175	182
Silt, very sandy, slightly clayey, pale-brown; sand is very fine to fine	182	185
Sand, very fine to very coarse; trace of fine gravel below 190 ft; interbedded clay lenses from 200 to 205 ft	185	215
Sand, very fine- to fine-grained, slightly silty, a few rootlets; some medium to very coarse sand with a trace of gravel below 220 ft	215	225
Sandstone, very fine- to fine-grained, moderately silty, pinkish-gray; interbedded silt lens below 255 ft	225	264
Clay, slightly silty, pinkish-gray	264	265
Sand, very fine to very coarse, little fine gravel; rare medium gravel below 270 ft	265	275
Sand, gravelly; very fine sand to fine gravel, a little medium, trace of coarse gravel	275	295
Gravel, sandy; very fine sand to coarse gravel with some very coarse gravel	295	299.5
Silt, moderately clayey, light reddish-brown; very clayey below 305 ft	299.5	310
Silt, moderately clayey, moderately sandy, light brownish-gray; sand is very fine	310	314.5
Sand, very fine to medium; very fine to very coarse with a little fine gravel below 320 ft	314.5	325
Sand, gravelly; very fine sand to medium gravel with a trace of coarse gravel, principally limestone	325	328
Silt to siltstone, slightly clayey, slightly sandy, light brownish-gray; sand is very fine to fine	328	336
Sandstone, very fine-grained, moderately silty, pinkish-gray, very calcareous, moderately consolidated, interbedded limy lenses	336	340
Sand, gravelly; medium sand to medium gravel, principally limestone	340	344
Tertiary System:		
Oligocene Series (White River Group)-		
Brule Formation		
Silt to siltstone, slightly clayey, light-brown; slightly calcareous from 350 to 365 ft, moderately calcareous below 365 ft --	344	380

Test Hole 15N-55W-6bbb
(Field No. 17-B-69)

Location: 73 ft south and 1 ft east of NW cor. sec. 6, T. 15 N., R. 55 W.
Ground altitude: 4,840 ft (a)
Depth to water: 153.1 ft (July 28, 1969)

	Depth, in Feet	
	From	To
Quaternary System-undifferentiated		
Silt, moderately clayey, moderately sandy, dark grayish-brown; sand is very fine to very coarse; very sandy, brown below 3 ft ---	0	3.5
Tertiary System:		
Pliocene Series-		
Ogallala Formation		
Sand, gravelly; very fine sand to very coarse gravel, moderately silty ----------	3.5	7
Silt, moderately sandy, slightly clayey, brown, very calcareous; pinkish-white and light reddish-brown below 7.5 ft ----------	7	10
Sand, very fine to coarse with a little gravel, very silty; gravelly below 12 ft ----------	10	15
Silty sand to sandy silt, moderately clayey, yellowish-red and pinkish-gray; sand is very fine to medium; in part lime-cemented --	15	20
Silty sand to sandy silt, slightly clayey, light reddish-brown; sand is very fine to medium ----------	20	20.7
Sandstone, very fine- to coarse-grained, pinkish-white, very calcareous, moderately consolidated ----------	20.7	21.3
Silty sand to sandy silt, moderately clayey, light-brown; sand is very fine to coarse; some marly areas; sand is very fine to medium below 26 ft ----------	21.3	29.7
Limestone, white; sandy below 30 ft ----------	29.7	31.3
Sand, very fine to medium, marly; no marl below 35.6 ft ----------	31.3	36.5
Silt, moderately clayey, moderately sandy, brown, moderately calcareous; sand is very fine to medium; some marly areas -------	36.5	39.8
Sand, slightly gravelly; very fine sand to fine gravel ----------	39.8	40
Silt, moderately sandy, slightly clayey, brown, moderately calcareous; sand is very fine ----------	40	42
Silty sand to sandy silt, slightly clayey, reddish-brown, very calcareous; sand is very fine to fine; pinkish-gray below 44 ft ----------	42	50
Sand, very fine to medium, some marly areas ---	50	54
Silt, moderately clayey, moderately sandy, brown; sand is very fine to fine; marly		

	Depth, in Feet	
	From	To
15N-55W-6bbb--continued		
Tertiary-Pliocene-Ogallala--continued		
areas from 55.3 to 57.5 ft; yellowish-brown below 57.5 ft	54	60
Sand, very fine to fine, moderately silty	60	62.5
Gravel, sandy; coarse sand to coarse gravel; medium sand to medium gravel below 70 ft	62.5	78.8
Silt, moderately clayey, reddish-brown; yellowish-red below 80 ft	78.8	84.5
Silt, very clayey, marly, yellowish-brown; light-brown and reddish-brown from 90 to 95 ft	84.5	98.8
Silty sand to sandy silt, slightly clayey, brown; sand is very fine to fine	98.8	100
Sand, very fine, slightly silty	100	109.5
Silt, moderately clayey, moderately sandy, reddish-brown; sand is very fine	109.5	115.5
Sand, very fine to medium, moderately silty; in part marly	115.5	124
Silt, slightly clayey, slightly sandy, brown; reddish-brown below 129 ft	124	130
Sand, very fine, moderately silty; marly below 139 ft	130	140
Silt, moderately sandy, slightly clayey, marly, pinkish-gray; sand is very fine	140	142
Sand, very fine to fine, moderately silty	142	146.5
Silt, slightly clayey, slightly sandy, brown; sand is very fine; reddish-brown from 150 to 151 ft; yellowish-brown from 151 to 155 ft	146.5	168.5
Sand, very fine to very coarse, much fine to coarse; marly below 170 ft	168.5	171
Silt, moderately clayey, moderately sandy, pink and brown; sand is very fine to fine; some marly areas; reddish-brown from 175 to 180 ft; pinkish-gray from 180 to 183 ft	171	183.4
Sandstone, very fine- to fine-grained, silty, light-gray, moderately calcareous, moderately consolidated; in part marly	183.4	183.7
Silt, very clayey, slightly sandy, reddish-brown; sand is very fine to fine, light-gray from 190.2 to 193 ft; pinkish-gray below 195 ft	183.7	200
Silty sand to sandy silt, slightly clayey, light-brown and white; sand is very fine to medium; marly areas; light-gray and pinkish-white below 205 ft	200	208.3
Sand, very fine to coarse with a trace of very coarse	208.3	210
Sand, slightly gravelly; very fine sand to fine gravel; marly sand from 215.3 to 216 ft	210	220

	Depth, in Feet	
	From	To
15N-55W-6bbb--continued		
Tertiary-Pliocene-Ogallala--continued		
Gravel, sandy, fine sand to medium gravel, much coarse sand to medium gravel; very coarse sand to medium gravel below 225 ft ---	220	240
Sand, very fine to coarse ----------	240	243.3
Sandy silt to silty sand, slightly clayey, brown; sand is very fine to fine; marly areas below 246 ft ----------	243.3	250
Silt, moderately clayey, moderately sandy, brown, sand is very fine; some marly areas --	250	265
Sandstone, very fine- to fine-grained, silty, pale-brown, slightly consolidated; some limy areas ----------	265	275
Silt, very sandy, slightly clayey, pale-brown; sand is very fine to fine ----------	275	277.5
Gravel, sandy; fine sand to coarse gravel, much very coarse sand to coarse gravel ------	277.5	280
Sand, gravelly; fine sand to fine gravel, much medium sand to fine gravel; much fine to very coarse sand below 280 ft -------	280	290
Gravel, sandy; medium sand to medium gravel, slightly silty, slightly clayey; in part marly ----------	290	295
Sand, gravelly; fine sand to fine gravel; thin marl lenses from 295 to 305 ft; much coarse sand to medium gravel from 300 to 305 ft; much fine to coarse sand below 305 ft ----------	295	309
Marl, sandy, pale-brown and white; sand is very fine to coarse ----------	309	310
Silt to siltstone, slightly clayey, light-brown, slightly calcareous ----------	310	312
Sand, very fine to medium, marly, slightly silty; very fine to coarse below 315 ft -----	312	316
Tertiary System:		
Oligocene Series (White River Group)-		
Brule Formation		
Silt to siltstone, slightly clayey, slightly sandy, yellowish-brown, slightly calcareous; sand is very fine ----------	316	350

Test Hole 15N-55W-15ccc
(Field No. 7-ANB-70)

Location: SW cor. sec. 15, T. 15 N., R. 55 W.
Ground altitude: 4,733.7 ft (a)
Depth to water: 117.5 ft (Oct. 17, 1970)

	Depth, in Feet	
	From	To
Tertiary System:		
Pliocene Series-		
Ogallala Formation		
Limestone, sandy, pinkish-gray and brown; sand is very fine to fine; some rootlets below 5 ft	0	10
Clay, moderately silty, reddish-brown, slightly calcareous, limy areas; slightly sandy, pinkish-gray below 15 ft; sand is very fine	10	20
Clay, moderately silty, brown with reddish-tint, limy areas; reddish-brown below 25 ft	20	33
Sand, very fine to coarse, a little very coarse; trace of fine to medium gravel below 35 ft	33	40
Sand, gravelly; very fine sand to fine gravel, some medium gravel	40	44
Clay, moderately silty, light brownish-gray, micaceous	44	45
Sand, gravelly; very fine sand to fine gravel, some medium gravel; interbedded silty clay lenses	45	50
Sandstone, very fine- to fine-grained, light-brown and light-gray, moderately calcareous, well consolidated; interbedded limestone lenses	50	64
Gravel, sandy; very fine sand to medium gravel, some coarse gravel; interbedded silty sand lenses and a trace of cobbles below 65 ft	64	70
Gravel, sandy; very fine sand to fine gravel, some medium to coarse with a trace of very coarse gravel; slightly coarser-grained below 75 ft	70	85
Clay, slightly silty, light reddish-brown, moderately calcareous, in part limy areas and slightly sandy; sand is very fine to fine	85	90
Clay, moderately sandy, slightly silty, micaceous, light-brown; sand is very fine to fine	90	95
Gravel, sandy; very fine sand to medium gravel, some coarse gravel; coarser-grained below 100 ft	95	112

	Depth, in Feet	
	From	To
15N-55W-15ccc--continued		
Tertiary-Pliocene-Ogallala--continued		
Clay, moderately sandy, moderately silty, brown, moderately calcareous; sand is very fine to fine	112	115
Clay, moderately sandy, moderately silty, pinkish-gray, moderately calcareous; sand is very fine to fine; limy areas	115	120
Clay, moderately silty, slightly sandy, light brownish-gray; sand is very fine to fine	120	125
Clay, moderately silty, reddish-brown, in part moderately calcareous, and limy areas; in part moderately sandy below 140 ft; sand is very fine to fine	125	150
Clay, moderately sandy, moderately silty, light-brown; some bentonite to 155 ft; moderately sandy below 155 ft; sand is very fine to fine	150	160
Clay, moderately silty, slightly sandy, light reddish-brown, slightly calcareous; sand is very fine to fine; some limy areas	160	170
Clay, slightly silty, pinkish-gray, moderately calcareous	170	175
Clay, slightly silty, reddish-brown	175	180
Sandstone, very fine- to fine-grained, very silty, pink, poorly consolidated, a few rootlets	180	195
Clay, moderately silty, sandy to gravelly, light-brown, some limy areas; very fine sand to fine gravel	195	201
Clay, very sandy, moderately silty, light reddish-brown; sand is very fine to medium with some coarser grains; finer-grained below 205 ft	201	210
Clay, very sandy, moderately silty, light-brown, moderately calcareous, limy areas; sand is very fine to fine	210	215
Clay, moderately sandy, slightly silty, light-brown; sand is very fine to fine	215	220
Clay, very sandy, slightly silty, pinkish-gray; sand is very fine to fine with some coarser grains; interbedded sandstone lenses; some olive-gray color below 225 ft	220	232.5
Sand, very fine to very coarse with a trace of fine gravel	232.5	235
Sand, slightly gravelly; fine sand to fine gravel, with some medium and a trace of coarse gravel	235	240
Clay, slightly silty, pinkish-gray, very calcareous	240	246
Sand, very fine to very coarse	246	250

	Depth, in Feet	
	From	To
15N-55W-15ccc--continued		
Tertiary-Pliocene-Ogallala--continued		
Clay, very sandy, moderately silty, brown, limy areas; sand is very fine to very coarse -----	250	253.5
Sand, very fine to very coarse with a little fine to medium gravel ----------	253.5	255
Sand, gravelly; very fine sand to medium gravel with a trace of coarse gravel --------	255	258.6
Sandstone, very fine- to fine-grained, moderately silty, pinkish-gray, very calcareous, poorly consolidated ----------	258.6	262
Clay, very sandy, moderately silty, pinkish-gray; sand is very fine to fine; interbedded sandstone lenses ----------	262	264
Sand, gravelly; very fine sand to fine gravel, a little medium with a trace of coarse to very coarse gravel ----------	264	268
Sand, very fine to very coarse with a trace of fine gravel; no gravel below 270 ft; clay lens about 275 ft ----------	268	278.6
Gravel, sandy; medium sand to medium gray with a trace of coarse gravel, principally limestone, siltstone and sandstone ----------	278.6	280
Sand, very fine to very coarse with a few medium to very coarse gravel grains; clayey from 280 to 282 ft ----------	280	285
Sand, very fine to very coarse with a few medium to coarse gravel grains to 290 ft; moderately silty to 286.5 ft; very silty from 291.8 to 292.3 ft ----------	285	295
Sandstone, very fine- to fine-grained, moderately silty, brown with pink tint, slightly calcareous, moderately consolidated, trace of rootlets; limy areas from 298.5 to 299 ft; some medium to coarse sand below 300 ft ----------	295	305
Sand, slightly gravelly; very fine sand to fine gravel, slightly silty; interbedded silty sand lenses ----------	305	310
Clay, silty, interbedded silty sand lenses ----	310	315
Sandstone, very fine- to fine-grained, moderately silty, moderately consolidated; interbedded silt lenses ----------	315	320
Silty sand to sandy silt, very fine to fine sand, slightly clayey; interbedded lime-cemented sandstone lenses ----------	320	325
Marl, very sandy, moderately silty, white; sand is very fine to fine; interbedded lime-cemented sandstone lenses ----------	325	330
Sandstone, very fine- to fine-grained, moderately silty, pinkish-gray, moderately calcareous, moderately consolidated ---------	330	335

	Depth, in Feet From	To
15N-55W-15ccc--continued		
Tertiary-Pliocene-Ogallala--continued		
Clay, very sandy, moderately silty, pinkish-gray; sand is very fine; some interbedded sandstone lenses	335	350
Sandstone, very fine- to fine-grained, moderately silty, pinkish-gray and brown, moderately consolidated, interbedded clay lenses, some rootlet fragments; trace of medium sand below 360 ft; interbedded limy layers below 370 ft	350	375
Sand and gravel; very fine sand to fine gravel, a little medium gravel, gravel principally limestone, sandstone and some siltstone fragments	375	380
Silt, very clayey, very sandy, light-gray, slightly calcareous; sand is very fine to fine; interbedded sandstone lenses; limy areas	380	385
Sandstone, very fine- to fine-grained, slightly silty, light-gray, moderately calcareous, moderately consolidated; interbedded thin silt lenses	385	390
Chert, olive-gray	390	393
Clay, moderately silty, light olive-gray	393	398
Tertiary System:		
Oligocene Series (White River Group)-		
Brule Formation		
Silt to siltstone, slightly clayey, light-brown; moderately calcareous; some light-brownish gray below 400 ft; some limy areas below 405 ft	398	415
Silt to siltstone, slightly clayey, light-brown, moderately calcareous	415	420

Test Hole 15N-56W-36ddd
(Field No. 18-B-69)

Location: 49 ft north and 349 ft west of SE cor. sec. 36, T. 15 N., R. 56 W.
Ground altitude: 4,866 ft (a)
Depth to water: 141.6 ft (July 28, 1969)

	Depth, in Feet From	To
Tertiary System:		
Pliocene Series-		
Ogallala Formation		
Sandstone, very fine- to medium-grained, some coarse sand to very coarse gravel, pinkish-gray, very calcareous, poorly consolidated;		

	Depth, in Feet	
	From	To
15N-56W-36ddd--continued		
Tertiary-Pliocene-Ogallala--continued		
in part marly; brown and reddish-yellow below 10 ft; interbedded silt lens below 10 ft	0	15
Sand, very fine to medium, slightly silty; in part marly; very fine to fine below 20 ft	15	25
Sand, gravelly; very fine sand to very coarse gravel, silty	25	26.3
Silt, moderately sandy, slightly clayey, reddish-brown and pinkish-gray, moderately calcareous; sand is very fine to medium	26.3	29.1
Sandstone, very fine- to medium-grained, slightly silty, pinkish-gray, very calcareous, moderately consolidated	29.1	31
Sand, very fine to fine, slightly silty, marly areas	31	35
Silt, slightly clayey, slightly sandy, reddish-brown; marly to 36.5 ft; sand is very fine to fine; brown below 36.5 ft	35	39
Sand, very fine to fine, moderately silty; marly from 43 to 44.2 ft; interbedded silt lens 45 to 45.8 ft and below 47 ft	39	50
Sand, very fine, moderately silty	50	53.7
Silt, moderately sandy, slightly clayey, brown; sand is very fine to fine, some reddish-brown below 56.2 ft; very sandy below 60.7 ft, some marly areas	53.7	66.7
Sand, very fine to medium with a trace of coarse to very coarse to 75 ft; slightly silty; marly below 75.6 ft	66.7	76.7
Silty sand to sandy silt, slightly clayey, yellowish-red; sand is very fine to fine	76.7	80
Sand, very fine to medium, some coarse, slightly silty; marly below 82.4 ft	80	83.8
Sand, very fine to medium, silty, marly	83.8	89.9
Silt, slightly clayey, slightly sandy, brown	89.9	92.3
Sand, very fine to fine, marly	92.3	95
Silt, moderately sandy, slightly clayey, light reddish-brown; sand is very fine; light-brown below 95.9 ft; marly below 100 ft	95	101.5
Sand, very fine, slightly silty	101.5	106.5
Silt to siltstone, slightly clayey, pink; light-brown from 108.5 to 110 ft; reddish-brown below 110 ft	106.5	118.1
Sand, gravelly; fine sand to fine gravel; interbedded silt lenses	118.1	125
Sand, very fine to fine, moderately silty	125	127.5
Marl, very sandy, very silty, pinkish-white	127.5	130

	Depth, in Feet	
	From	To
15N-56W-36ddd--continued		
Tertiary-Pliocene-Ogallala--continued		
Silt, slightly clayey, marly, brown; pinkish-gray from 133.8 to 134 ft; yellowish-brown below 134 ft	130	134.8
Marl, slightly clayey, slightly silty, pinkish-gray	134.8	135.5
Silt to siltstone, slightly clayey, marly, light yellowish-brown	135.5	138
Silt, slightly clayey, marly, light-brown; very sandy below 148 ft; sand is very fine	138	156.5
Tertiary System:		
Oligocene Series (White River Group)-		
Brule Formation		
Silt, slightly clayey, pale-brown, slightly calcareous; slightly sandy below 190 ft; sand is very fine	156.5	210

Test Hole 15N-57W-6bbb
(Field No. 6-B-69)

Location: 165 ft south and 36 ft east of NW cor. sec. 6, T. 15 N., R. 57 W.
Ground altitude: 5,005 ft (a)
Depth to water unknown; Test Hole caved at 7 ft (July 8, 1969)

	Depth, in Feet	
	From	To
Quaternary System-undifferentiated		
Silt, very sandy, slightly clayey, dark grayish-brown; sand is very fine to medium	0	2.5
Silty sand to sandy silt, slightly clayey, brown; sand is very fine to coarse	2.5	3.5
Tertiary System:		
Pliocene Series-		
Ogallala Formation		
Gravel, sandy; very fine sand to very coarse gravel	3.5	30.5
Silty sand to sandy silt, moderately clayey, light-brown; sand is very fine to fine	30.5	33.3
Clay, moderately silty, slightly sandy, brown; sand is very fine; some interbedded sandstone to siltstone lenses below 36 ft	33.3	37.5
Silt to siltstone, moderately clayey, slightly sandy, pinkish-gray; slightly calcareous to 39 ft; sand is very fine; light-brown below 39 ft	37.5	43.5
Silty sand to sandy silt, slightly clayey, brown; sand is very fine to fine	43.5	46.5
Sand and gravel; fine sand to medium gravel	46.5	50.5

	Depth, in Feet	
	From	To
15N-57W-6bbb--continued		
Tertiary-Pliocene-Ogallala--continued		
Silty sand to sandy silt, slightly clayey, pale-olive; sand is very fine to medium -----	50.5	55
Silt, slightly clayey, light reddish-brown; brown below 50 ft ----------	55	60
Sandstone, very fine- to medium-grained, pinkish-gray, moderately calcareous, well consolidated ----------	60	63.3
Silt, moderately clayey, moderately sandy, reddish-brown; sand is very fine to fine ----	63.3	67.7
Silty sand to sandy silt, slightly clayey, light-brown, slightly calcareous; sand is very fine to medium ----------	67.7	70.4
Silt, moderately sandy, slightly clayey, pinkish-gray, moderately calcareous; sand is very fine to medium; gravelly below 72.3 ft ----------	70.4	75
Sand, gravelly; very fine sand to fine gravel, silty; in part marly ----------	75	80
Silt, moderately sandy, slightly clayey, pinkish-gray; sand is very fine to very coarse with some fine gravel ----------	80	82.3
Gravel, sandy; medium sand to fine gravel; some medium to coarse gravel below 85 ft; much medium sand to medium gravel ----------	82.3	121
Sandstone, very fine- to fine-grained, silty, marly, light-gray, moderately calcareous, moderately consolidated; brown below 127.2 ft ----------	121	130
Silt, moderately sandy, slightly clayey, light-brown and pinkish-gray, moderately calcareous; sand is very fine to fine -------	130	136.3
Sandstone, very fine-grained, silty, light-brown and pinkish-gray, very calcareous, poorly consolidated ----------	136.3	140.5
Silt, moderately clayey, moderately sandy, brown and pinkish-white, moderately calcareous; sand is very fine to fine; marly areas ----------	140.5	145
Silty sand to sandy silt, slightly clayey, light-brown and pinkish-gray, slightly calcareous; sand is very fine to fine; light-brown below 146 ft ----------	145	152
Siltstone to sandstone, slightly clayey, very silty, brown, slightly calcareous; sand is very fine ----------	152	158
Tertiary System:		
Oligocene Series (White River Group)-		
Brule Formation		
Silt to siltstone, slightly clayey, light-brown, slightly calcareous, marly areas		

	Depth, in Feet	
	From	To
15N-57W-6bbb--continued		
Tertiary-Oligocene-Brule--continued		
from 190 to 195 ft	158	230
Sand, very fine to fine, silty	230	235
Silt to siltstone, slightly clayey, pale-brown, slightly calcareous	235	240

Test Hole 15N-59W-2aaa
(Field No. 4-B-69)

Location: 40 ft south and 24 ft west of NE cor. sec. 2, T. 15 N., R. 59 W.
Ground altitude: 5,207 ft (Lindberg 7.5 minute quadrangle)
Depth to water: 86.5 ft (June 6, 1969)

	Depth, in Feet	
	From	To
Quaternary System-undifferentiated		
Silt, slightly clayey, slightly sandy, dark grayish-brown; sand is very fine to fine	0	0.5
Silt, moderately sandy, slightly clayey, pale-brown, moderately calcareous; sand is very fine to fine	0.5	3
Tertiary System:		
Pliocene Series-		
Ogallala Formation		
Gravel, sandy, very fine sand to very coarse gravel, silty; interbedded limy lenses	3	18.3
Silt, moderately clayey, moderately sandy, reddish-brown and brown; sand is very fine to fine	18.3	21
Gravel, sandy; very fine sand to very coarse gravel; some interbedded silty-clay areas	21	38.8
Silt, clayey, sandy, yellowish-red and reddish-brown; sand is very fine to fine with some medium	38.8	47
Sand, fine to very coarse, some fine gravel	47	50.3
Sand, very fine to medium, moderately silty; very fine to coarse with a trace of gravel below 52.3 ft	50.3	55
Sand, gravelly; very fine sand to coarse gravel, some silty areas	55	70.1
Silt, moderately sandy, slightly clayey, light reddish-brown and light-brown, some volcanic ash	70.1	90
Sand, very fine to fine, silty, in part clayey and consolidated	90	160
Silt, very sandy, slightly clayey, yellowish-brown; sand is very fine	160	170
Sandstone, very fine- to fine-grained, grayish-brown and brown, moderately consolidated; some interbedded marly areas; well		

	Depth, in Feet	
	From	To
15N-59W-2aaa--continued		
Tertiary-Pliocene-Ogallala--continued		
consolidated below 182.5 ft; some interbedded siltstone lenses below 186 ft --------	170	190
Gravel, principally siltstone fragments -------	190	192.9
Silty sand to sandy silt, slightly clayey, brown and pinkish-gray; sand is very fine to fine; some limy areas; some interbedded siltstone lenses; sand is fine to coarse below 222.8 ft ----------	192.9	227.8
Tertiary System:		
Oligocene Series (White River Group)-		
Brule Formation		
Silt to siltstone, clayey, yellowish-brown and brown, in part slightly calcareous ------	227.8	280

Test Hole 16N-53W-6bbb
(Field No. 26-B-69)

Location: 16 ft south and 25 ft east of NW cor. sec. 6, T. 16 N., R. 53 W.
Ground altitude: 4,759 ft (a)
Depth to water: 249.7 ft (Oct. 1, 1969)

	Depth, in Feet	
	From	To
Quaternary System-undifferentiated		
Silt, slightly clayey, slightly sandy, dark grayish-brown; sand is very fine with some coarser grains ----------	0	1
Silt, slightly clayey, slightly sandy, brown; sand is very fine with some coarser grains --	1	3
Sand, very fine to fine, some gravel grains; moderately silty below 5 ft ----------	3	8.4
Tertiary System:		
Pliocene Series-		
Ogallala Formation		
Limestone, pale-brown; pinkish-white; sandy below 12 ft; sand is very fine ----------	8.4	13.8
Marl, very sandy, pale-brown; sand is very fine to medium ----------	13.8	18
Sandstone, very fine- to fine-grained, pale-brown, very calcareous, moderately consolidated; some gravel grains from 19.5 to 20 ft; sand is very fine to medium, slightly calcareous below 20 ft ----------	18	22.5
Gravel, sandy; fine sand to very coarse gravel, marly ----------	22.5	32.2
Silty sand to sandy silt, slightly clayey, yellowish-red and reddish-yellow; sand is very fine to medium ----------	32.2	42

	Depth, in Feet	
	From	To
16N-53W-6bbb--continued		
Tertiary-Pliocene-Ogallala--continued		
Sandstone, very fine- to medium-grained, silty, marly, pinkish-gray, moderately consolidated; some coarse sand and gravel grains below 50.5 ft	42	55
Sandstone, very fine- to fine-grained, pinkish-gray, very calcareous, poorly consolidated	55	57.5
Sand, very fine to coarse; slightly gravelly below 65 ft; interbedded silt lenses from 65 to 68 ft	57.5	70
Sand, very fine to medium; very fine to fine below 82 ft	70	84.5
Silty sand to sandy silt, slightly clayey, sand is very fine to medium; some coarse sand to fine gravel with marl areas from 86 to 90 ft	84.5	91
Silt to siltstone, slightly clayey, moderately sandy, yellowish-brown; sand is very fine to fine	91	99.5
Sand, slightly gravelly; fine sand to coarse gravel	99.5	111.5
Silt, slightly clayey, white	111.5	113
Sand, very fine to medium, some coarse sand to fine gravel	113	115
Sand, very fine to very coarse with some fine to medium gravel	115	125
Sand, very fine to fine, some coarser grains, slightly silty, marly areas	125	129
Silt, slightly clayey, slightly sandy, brown; sand is very fine to coarse; some marly areas	129	130
Sand, very fine to very coarse, some gravel grains, moderately silty, marly	130	130.5
Sand, very fine to fine with some medium sand to fine gravel, moderately silty; marly areas below 131 ft	130.5	135
Sandstone, very fine- to fine-grained, marly, moderately silty, pinkish-white, moderately consolidated	135	141
Silt, moderately clayey, moderately sandy, light reddish-brown; sand is very fine to coarse; marly and pink from 143 to 143.5 ft; light-brown and pinkish-gray below 143.5 ft; sand is very fine to coarse	141	145
Marl, sandy, silty, light-brown and pinkish-gray; sand is very fine to very coarse	145	148
Silt, moderately sandy, slightly clayey, brown; sand is very fine to coarse; marly areas	148	152.5

	Depth, in Feet From	To
16N-53W-6bbb--continued		
Tertiary-Pliocene-Ogallala--continued		
Marl, very sandy, silty, pale-brown; sand is very fine to fine with some medium sand to fine gravel	152.5	153.8
Sand, very fine to medium with some coarse, silty and marly areas	153.8	155
Silty sand to sandy silt, marly, light-brown and pinkish-white	155	158
Sand, gravelly; very fine sand to coarse gravel; silty from 162 to 162.2 ft	158	169
Silt, very sandy, moderately clayey, pink, moderately calcareous; sand is very fine to fine	169	180
Marl, very sandy, silty, pinkish-white; sand is very fine to fine	180	182
Limestone, marly, sandy, white; sand is very fine to fine	182	185.8
Sand, very fine to fine, very silty	185.8	190
Marl, silty, sandy, light-gray and pale-brown -	190	194
Sand, very fine to coarse with a trace of gravel	194	195
Sand, gravelly; very fine sand to coarse gravel, interbedded silty sand lenses	195	198.5
Sand, very fine to fine, moderately silty, in part marly; sand is very fine to medium below 200 ft	198.5	202
Silt, slightly clayey, white and brown; marly areas; moderately sandy below 205 ft; sand is very fine to fine; light olive-green from 210 to 214.5 ft; grayish-brown below 214.5 ft	202	215
Silt, moderately clayey, pale-brown with some light greenish-gray	215	215.5
Limestone, moderately sandy, silty, light-gray, some brown; sand is very fine to fine -	215.5	216.5
Silt, slightly clayey, slightly sandy, light brownish-gray; sand is very fine; very sandy, grayish-brown from 217 to 220 ft; brown from 220 to 222.8 ft; limy below 222.8 ft	216.5	223.1
Silt, very sandy, slightly clayey, light brownish-gray; sand is very fine; limy areas; brown from 227 to 232 ft	223.1	233
Silt, slightly clayey, slightly sandy, grayish-brown; sand is very fine; marly areas	233	236
Silt to siltstone, slightly clayey, brown; some interbedded sand lenses; sand is very fine; marly areas	236	245

	Depth, in Feet	
	From	To
16N-53W-6bbb--continued		
Tertiary-Pliocene-Ogallala--continued		
Silty sand to sandy silt, slightly clayey, brown; sand is very fine; light grayish-brown below 24.9 ft; some marly areas -------	245	255
Silt, very sandy, slightly clayey, pale-brown and white; sand is very fine; some marly areas ----------	255	257.5
Silty sand to sandy silt, slightly clayey, brown; sand is very fine ----------	257.5	270
Silt to siltstone, very sandy, slightly clayey, pale-brown; sand is very fine -------	270	275
Silty sand to sandy silt, slightly clayey, brown; sand is very fine ----------	275	295
Tertiary System:		
Oligocene Series (White River Group)-		
Brule Formation		
Silt to siltstone, slightly clayey, slightly sandy, brown; sand is very fine; yellowish-brown from 335 to 345 ft ----------	295	350

Test Hole 16N-53W-17ccc
(Field No. 14-ANB-70)

Location: SW cor. sec. 17, T. 16 N., R. 53 W.
Ground altitude: 4,689.2 ft (a)
Depth to water: 231.3 ft (Sept. 1, 1969)

	Depth, in Feet	
	From	To
Quaternary System--indifferentiated		
Silt, slightly clayey, dark grayish-brown -----	0	4
Tertiary System:		
Pliocene Series-		
Ogallala Formation		
Limestone, sandy to gravelly, white to pinkish-gray; very fine sand to very coarse gravel, trace of pebbles ----------	4	5
Sandstone, very fine- to fine-grained, a little medium, slightly silty, pinkish-gray, very calcareous, well consolidated ----	5	10
Sandstone, very fine- to medium-grained, some coarse sand to fine gravel, slightly silty, light-brown, very calcareous, well consolidated, trace of seeds ----------	10	15
Sandstone, very fine- to fine-grained, moderately silty, brown, slightly calcareous, moderately consolidated, trace of rootlets; trace of medium sand to fine gravel below 20 ft ----------	15	25
Sandstone, very fine to very coarse, little fine gravel, moderately silty, reddish-brown,		

	Depth, in Feet	
	From	To
16N-53W-17ccc--continued		
Tertiary-Pliocene-Ogallala--continued		
slightly calcareous, well consolidated, trace of seeds	25	30
Gravel, sandy; very fine sand to very coarse gravel; interbedded clay lenses below 33 ft	30	40
Sand, gravelly; very fine sand to fine gravel, a little medium to coarse gravel, much very coarse sand; clayey below 48 ft	40	55
Gravel, sandy; very fine sand to medium gravel, some coarse to very coarse gravel with a trace of pebbles, much very coarse sand	55	65
Sand, gravelly; very fine sand to fine gravel, a little medium, trace of coarse gravel, much coarse sand	65	73
Sandstone, very fine- to very coarse-grained, trace of gravel, slightly silty, pinkish-gray, moderately calcareous, moderately consolidated; interbedded limestone lenses below 85 ft	73	100
Clay, silty, reddish-brown; interbedded limestone lenses; slightly sandy below 105 ft; sand is very fine to fine	100	115
Marl, silty, slightly sandy, pinkish-white; sand is very fine to fine	115	120
Clay, silty, pinkish-gray, slightly calcareous, some limy areas; sandy below 143.5 ft	120	145
Gravel, sandy; very fine sand to coarse gravel, some very coarse gravel, few pebbles, much coarse sand	145	170.5
Clay, slightly silty, slightly sandy, brown; sand is very fine; moderately silty, moderately sand below 178.5 ft	170.5	185
Silty sand to sandy silt, slightly clayey, brown; sand is very fine to medium, some coarse, much fine	185	196
Clay, marly, pinkish-white, some very fine to fine sand	196	200
Clay, moderately silty, moderately sandy, marly, pale-yellow; sand is very fine to fine	200	210
Silty sand to sandy silt, slightly clayey, pale-yellow, trace of rootlets; interbedded silty sandstone	210	215
Sandstone, very fine-grained, slightly silty, pale-olive, moderately calcareous, poorly consolidated, some limy areas; pale-yellow below 220 ft; interbedded sandy clay lenses below 225 ft	215	230
Clay, moderately silty, moderately sandy, pale-olive, slightly calcareous, limy areas;		

	Depth, in Feet	
	From	To
16N-53W-17ccc--continued		
Tertiary-Pliocene-Ogallala--continued		
interbedded sandstone lenses to 236 ft; sand is very fine to fine	230	240
Silty sand to sandy silt, moderately clayey, pinkish-gray; sand is very fine to fine	240	245
Sand, slightly gravelly; very fine sand to fine gravel, trace of medium gravel, much coarse sand	245	254
Clay, moderately silty, reddish-brown; very sandy below 260 ft; sand is very fine to medium	254	265
Sand, slightly gravelly; very fine sand to fine gravel, much coarse sand; some medium gravel below 270 ft; clay lens about 274 ft	265	275
Gravel, sandy; very fine sand to coarse gravel-	275	280.5
Tertiary System:		
Oligocene Series (White River Group)-		
Brule Formation		
Silt, to siltstone, light-brown, in part slightly calcareous, some very fine sand	280.5	320

Test Hole 16N-53W-34ddd
(Field No. 34-B-69)

Location: 19 ft north and 3.5 ft west of SE cor. sec. 34, T. 16 N., R. 53 W.
Ground altitude: 4,621 ft (a)
Depth to water unknown; Test Hole caved at 79 ft (Oct. 10, 1969)

	Depth, in Feet	
	From	To
Quaternary System-undifferentiated		
Silt, slightly clayey, dark grayish-brown, trace of fine sand; dark grayish-brown below 1.5 ft; some sand and gravel grains	0	3.5
Tertiary System:		
Pliocene Series-		
Ogallala Formation		
Silt, moderately sandy, slightly clayey, grayish-brown; sand is very fine with some fine sand to fine gravel	3.5	5
Silt, very sandy, slightly clayey, yellowish-brown; sand is very fine to medium with some coarse sand to fine gravel	5	7
Sand, gravelly; fine sand to coarse gravel, much medium to coarse sand	7	15
Gravel, sandy; fine sand to coarse gravel, much very coarse sand to fine gravel	15	20
Silty sand to sandy silt, slightly clayey, brown; sand is very fine to fine with		

	Depth, in Feet	
	From	To
16N-53W-34ddd--continued		
Tertiary-Pliocene-Ogallala--continued		
some medium sand to fine gravel grains; reddish-yellow below 28.5 ft	20	29
Sand, slightly gravelly; very fine sand to coarse gravel, silty	29	30
Sand, very fine to very coarse; very fine to fine, moderately silty below 31.5 ft	30	32.8
Silt, moderately clayey, slightly sandy, reddish-brown; sand is very fine to coarse	32.8	34.5
Silty sand to sandy silt, slightly clayey, slightly gravelly, reddish-brown; very fine sand to coarse gravel; sand is very fine to medium with some coarse below 35 ft	34.5	36
Sandstone, very fine- to medium-grained with some coarse sand to fine gravel, brown, poorly consolidated	36	43.8
Claystone, silty, brown; sandy below 44.5 ft; sand is very fine to fine	43.8	45
Sandstone, very fine- to medium-grained, some coarse to very coarse sand, brown, poorly consolidated	45	50
Gravel, sandy; fine sand to medium gravel	50	55
Sandstone, very fine- to very coarse-grained, light-brown, poorly consolidated	55	63.5
Sand, gravelly; very fine sand to coarse gravel, much coarse sand to fine gravel	63.5	71
Silt, very sandy, slightly clayey, brown; sand is very fine to coarse with some fine gravel-	71	71.3
Marl, very sandy, silty, pinkish-white; sand is very fine to very coarse, some fine gravel	71.3	75
Silty sand to sandy silt, slightly clayey, light-brown, pink, brown and reddish-brown, slightly calcareous; sand is very fine to fine below 88.8 ft	75	96.8
Marl, very sandy, moderately silty, pinkish-white and light-brown	96.8	99
Silty sand to sandy silt, slightly clayey, light-brown; sand is very fine to medium; marly areas; pinkish-white below 100 ft	99	106.8
Sand, fine to very coarse	106.8	109.7
Sand, slightly gravelly; medium sand to coarse gravel, much coarse to very coarse sand	109.7	110
Sand, gravelly; medium sand to coarse gravel; marly areas and interbedded silt lenses	110	117
Sand, very fine to fine with some medium sand to fine gravel, moderately silty	117	120.5
Marl, very sandy, moderately silty, pinkish-white; sand is very fine to fine; light-brown below 121 ft; interbedded silt from 121 to 123.3 ft	120.5	126.4

	Depth, in Feet	
	From	To
16N-53W-34ddd--continued		
Tertiary-Pliocene-Ogallala--continued		
Silty sand to sandy silt, slightly clayey, light-brown; very calcareous below 128.5 ft; sand is very fine; pinkish-white below 128.5 ft	126.4	131.8
Silt to siltstone, slightly clayey, reddish-brown; marly below 134 ft; some very fine sand	131.8	135
Silty sand to sandy silt, slightly clayey, brown; sand is very fine to fine; some sandstone; marly areas from 139 to 140 ft; pinkish-white below 140 ft	135	144.1
Silt, moderately sandy, slightly clayey, brown and white, very calcareous; sand is very fine; some limy areas	144.1	145.2
Marl, very sandy, very silty, pinkish-white with some brown; sand is very fine to fine; some sandstone	145.2	145.5
Silty sand to sandy silt, slightly clayey, pink, some light-brown, very calcareous; sand is very fine to medium, some coarse	145.5	149
Marl, very sandy, white; sand is very fine to medium	149	149.2
Sand, very fine to medium with some coarse sand to medium gravel, moderately silty; some clay lenses below 150 ft	149.2	153
Sand, fine to very coarse with some fine to coarse gravel, moderately silty; marly areas below 155 ft	153	157.7
Silt, moderately clayey, moderately sandy, pinkish-white, moderately calcareous, sand is very fine; brown, some marly areas below 161 ft	157.7	162
Silty sand to sandy silt, slightly clayey, brown; sand is very fine with a trace of fine to coarse; slightly calcareous below 165 ft	162	165.8
Silt, moderately sandy, slightly clayey, pinkish-white, moderately calcareous; sand is very fine with some fine to coarse sand	165.8	167
Silty sand to sandy silt, slightly clayey, brown; sand is very fine with some fine sand to fine gravel; light yellowish-brown below 170 ft	167	170.5
Sand, slightly gravelly; medium sand to fine gravel, much coarse to very coarse sand, silty	170.5	171
Silt to siltstone, moderately clayey, light-brown, very calcareous; some coarse sand to fine gravel	171	171.8

	Depth, in Feet	
	From	To
16N-53W-34ddd--continued		
Tertiary-Pliocene-Ogallala--continued		
Silt, very clayey, reddish-brown; some coarse sand to fine gravel; brown from 175 to 180 ft; sand is very fine to fine below 180 ft	171.8	183
Silt, moderately clayey, light-gray; marly areas; light greenish-gray and reddish-brown below 183.2 ft; some fine to coarse sand	183	185
Silty sand to sandy silt, slightly clayey, light-gray; some pale-yellow to 186 ft; sand is very fine	185	190
Silt, very sandy, moderately clayey, light-gray; sand is very fine	190	192.5
Sand, fine to very coarse with a trace of fine gravel	192.5	195
Sand, slightly gravelly; very fine sand to fine gravel	195	201.4
Silt, moderately clayey, light-brown, some coarse sand to fine gravel; reddish-brown below 202.5 ft	201.4	205
Silty sand to sandy silt, slightly clayey, brown; sand is very fine to medium; some very coarse sand and marly areas below 206.5 ft	205	207
Silt, slightly clayey, brown; yellowish-brown from 210 to 214 ft; some siltstone below 214 ft; marly areas below 215.8 ft	207	220
Silt, moderately sandy, slightly clayey, brown; sand is very fine; slightly calcareous from 221.9 to 222.1 ft; yellowish-brown from 221.5 to 225 ft	220	233.8
Sand, very fine to fine, moderately silty, some interbedded sandstone; slightly clayey below 235 ft	233.8	236
Sand, very fine to very coarse, slightly silty	236	240
Sand, gravelly; very fine sand to fine gravel, mostly coarse to very coarse sand; silty sand lens about 245 ft, some medium gravel below 245 ft; mostly medium to coarse sand from 250 to 255 ft	240	255
Sand, gravelly; very fine sand to medium gravel, mostly coarse to very coarse sand	255	265
Sand and gravel; fine sand to coarse gravel, mostly medium gravel	265	270
Sand, gravelly; fine sand to medium gravel, mostly coarse sand to fine gravel	270	273
Silty sand to sandy silt, slightly clayey, pinkish-gray, pale-brown and light-gray; sand is very fine to fine	273	278.5

	Depth, in Feet	
	From	To
16N-53W-34ddd--continued		
Tertiary-Pliocene-Ogallala--continued		
Silt, very sandy, slightly clayey, pinkish-gray, moderately calcareous; sand is very fine; slightly sandy, marly from 279.4 to 280 ft; moderately clayey, brown below 280 ft	278.5	285
Sand, very fine to medium, slightly silty	285	287
Sand, gravelly; very fine sand to medium gravel; no medium gravel from 290 to 300 ft	287	309.5
Silt, slightly clayey, slightly sandy, light-gray; sand is very fine to medium; light-brown below 310 ft	309.5	311
Silt, moderately clayey, slightly sandy, light greenish-gray; sand is very fine to medium; pale-olive below 317.4 ft	311	325
Clay, silty, light-green	325	330
Silty sand to sandy silt, slightly clayey, light brownish-gray; sand is very fine; some medium sand below 33.5 ft	330	335
Sand, gravelly; fine sand to very coarse gravel	335	345.9
Silt, moderately clayey, light-brown, slightly calcareous; moderately calcareous below 347 ft	345.9	350
Sand, very fine, moderately silty; marly from 353.7 to 354 ft	350	360
Siltstone to sandstone, slightly clayey, silty, marly, light-gray, slightly calcareous; sand is very fine	360	362.5
Tertiary System:		
Oligocene Series (White River Group)-		
Brule Formation		
Silt to siltstone, slightly clayey, pale-brown, slightly calcareous	362.5	370
Silt to siltstone, slightly clayey, yellowish-brown, slightly calcareous; brown from 370.5 to 380 ft	370	390

Test Hole 16N-54W-15ccc
(Field No. 4-ANB-70)

Location: 42 ft north and 26 ft east of SW cor. sec. 15, T. 16 N., R. 54 W.
Ground altitude: 4,768.7 ft (a)
Depth to water: 224.5 ft (Oct. 17, 1970)

	Depth, in Feet	
	From	To
Quaternary System-undifferentiated		
Silt, slightly clayey, dark grayish-brown -----	0	2
Tertiary System:		
Pliocene Series-		
Ogallala Formation		
Sandstone, gravelly; very fine to very coarse sand with some fine gravel ----------	2	5
Sand, gravelly; very fine sand to fine gravel, some medium gravel ----------	5	10
Sandstone, very fine to medium-grained, moderately silty, brown, well consolidated, some rootlets; interbedded limestone lenses below 15 ft ----------	10	30
Sandstone, very fine- to medium-grained, moderately silty, brown, well consolidated; some coarse to very coarse sand grains below 35 ft; some rootlets and interbedded limestone lenses below 40 ft ---------	30	55
Sandstone, very fine- to medium-grained with some coarse to very coarse, moderately silty, light-brown, moderately calcareous, well consolidated, a few rootlets; very fine to coarse below 60 ft ----------	55	65
Sandstone, very fine- to coarse-grained, moderately silty, pinkish-gray, moderately calcareous, well consolidated; some rootlets; interbedded limestone lenses below 70 ft; little fine gravel below 80 ft -------	65	85
Sand, gravelly; very fine sand to fine gravel with some medium to coarse gravel; interbedded sandstone lenses ----------	85	91
Sandstone, very fine- to medium-grained, moderately silty, white to pink, moderately calcareous, well consolidated; interbedded limestone lenses ----------	91	95
Sandstone, very fine- to fine-grained with some coarse to very coarse sand, moderately silty, pinkish-gray, moderately calcareous, moderately consolidated, some limy nodules ----------	95	100
Silt, moderately clayey, light-brown; some interbedded limestone lenses to 105 ft; reddish-brown below 105 ft; moderately sandy below 115 ft; sand is very fine to fine ----------	100	120

	Depth, in Feet	
	From	To
16N-54W-15ccc--continued		
Tertiary-Pliocene-Ogallala--continued		
Sandstone, very fine- to fine-grained, some medium to very coarse, moderately silty, pinkish-gray and light-gray, moderately calcareous, moderately consolidated; interbedded limestone lenses	120	125
Sand, very fine to very coarse with some fine gravel; interbedded limestone lens	125	130
Sand, gravelly; very fine sand to fine gravel, a little medium, trace of coarse to very coarse gravel	130	135
Gravel, sandy; very fine sand to medium gravel, with some coarse to very coarse gravel	135	145
Sand, gravelly; very fine sand to fine gravel, some medium to coarse gravel	145	152
Silt, very clayey, very sandy, pinkish-gray, moderately calcareous, some limy areas; sand is very fine to medium with a trace of coarse	152	155
Silt, very sandy, moderately clayey, marly areas; sand is very fine to fine with some medium; interbedded sandstone lenses below 160 ft	155	165
Silt, very sandy, moderately clayey, pinkish-gray, moderately calcareous; sand is very fine to very coarse; interbedded limestone lenses and marly areas below 170 ft	165	175
Silt, very clayey, sandy to gravelly, light olive-gray; very fine sand to coarse gravel	175	180
Sand, gravelly; very fine sand to medium gravel, some coarse gravel; very fine sand to fine gravel with a trace of coarse to very coarse gravel below 185 ft	180	190
Gravel, sandy; very fine sand to medium gravel, a little coarse gravel	190	200
Silt, very sandy, moderately clayey, pinkish-gray; sand is very fine to fine, some medium	200	205
Sand, very fine to fine, some medium, interbedded silty sand lenses, in part lime-cemented	205	220
Tertiary System:		
Oligocene Series (White River Group)-		
Brule Formation		
Siltstone, slightly clayey, slightly sandy, brown; sand is very fine; some limy areas to 235 ft	220	280

Test Hole 16N-54W-31ccc
(Field No. 24-B-69)

Location: 6 ft north and 133 ft east of SW cor. sec. 31, T. 16 N., R. 54 W.
Ground altitude: 4,751 ft (a)
Depth to water: 168.8 ft (Sept. 1, 1969)

	Depth, in Feet	
	From	To
Tertiary System:		
Pliocene Series-		
Ogallala Formation		
Road fill	0	2.0
Sand, very fine to medium with some coarse sand to fine gravel, moderately silty	2.0	3
Sand, gravelly; very fine sand to very coarse gravel	3	13.5
Sand, very fine to fine, silty; in part marly; some gravel grains below 15 ft	13.5	22.5
Sand, gravelly; very fine sand to coarse gravel with some very coarse gravel; in part cemented and silty; marly areas	22.5	45
Silty sand to sandy silt, marly, slightly clayey, pink and light-brown; sand is very fine to medium	45	49
Sand, very fine to medium with some coarse sand and gravel grains; marly areas	49	51
Sand, very fine to medium with some coarse to very coarse, in part cemented	51	53.5
Silt, moderately clayey, moderately sandy, light-gray; sand is very fine to fine, marly	53.5	55.6
Sand, gravelly; some interbedded sandstone and siltstone lenses	55.6	60
Silt, moderately sandy, slightly clayey, light greenish-gray and pale-olive; sand is very fine to medium; some marly areas; interbedded sandstone lens from 64 to 64.5 ft; pinkish-gray below 64.5 ft	60	70
Sand, very fine to fine, slightly silty; in part silty sand; some limy areas	70	79.5
Silt, moderately sandy, slightly clayey, brown, slightly calcareous; sand is very fine to fine	79.5	84
Sand, very fine to fine, slightly silty, slightly clayey	84	85
Sand, gravelly; fine sand to coarse gravel, much coarse sand to medium gravel	85	93
Silt, slightly clayey, reddish-yellow; light-brown below 95 ft	93	98
Silty sand to sandy silt, slightly clayey, light-brown and pink; sand is very fine to fine; reddish-brown below 101 ft	98	105

	Depth, in Feet	
	From	To
16N-54W-31ccc--continued		
Tertiary-Pliocene-Ogallala--continued		
Sand, very fine to medium, moderately silty; very fine to very coarse from 111 to 113 ft; very fine to fine below 113 ft	105	119.5
Silt, moderately clayey, light greenish-gray and pale yellow; white below 120 ft	119.5	122.5
Sand, slightly gravelly; very fine sand to fine gravel, much medium to coarse sand, in part silty	122.5	124
Sand, very fine to fine, slightly silty; slightly clayey from 124 to 125.3 ft; very fine to very coarse below 125.3 ft	124	127.3
Silt, moderately sandy, slightly clayey, reddish-yellow; sand is very fine; reddish-brown below 129 ft	127.3	130
Silty sand to sandy silt, slightly clayey, light-brown; sand is very fine to fine with some medium; some marly areas	130	148.3
Sand, very fine to medium with some coarse sand to fine gravel	148.3	149.8
Marl, sandy, pinkish-white; sand is very fine to fine with some medium to coarse	149.8	150.5
Sand, very fine to fine with some coarse sand to medium gravel grains	150.5	155
Silt, moderately clayey, brown; some marly areas	155	158.5
Silty sand to sandy silt, slightly clayey, yellowish-brown; sand is very fine to fine; light-brown from 160 to 165.1 ft; reddish-yellow below 165.1 ft; some marly areas	158.5	170
Silt, moderately sandy, slightly clayey, pale-brown and light-gray; sand is very fine to fine	170	170.5
Silty sand to sandy silt, slightly clayey, brownish-gray and grayish-brown; sand is very fine to fine; pinkish-gray and brown below 170.7 ft	170.5	179.5
Sand, very fine to medium with some coarse sand to fine gravel	179.5	180
Sand, gravelly; very fine sand to coarse gravel; silty sand lens below 190 ft	180	191
Gravel, sandy; fine sand to coarse gravel, much coarse sand to coarse gravel	191	199.2
Silt, very sandy, slightly clayey, brown; sand is very fine	199.2	200
Silty sand to sandy silt, slightly clayey, light reddish-brown and pale-brown; sand is very fine; light-brown and pinkish-gray below 205 ft; some marly areas	200	208.1

	Depth, in Feet	
	From	To
16N-54W-31ccc--continued		
Tertiary-Pliocene-Ogallala--continued		
Silt, moderately clayey, moderately sandy, brown; sand is very fine; some light olive-gray below 210 ft	208.1	225.5
Sand, very fine to coarse, much fine to coarse; very fine to fine, moderately silty below 246 ft	225.5	253
Silty sand to sandy silt, slightly clayey, light-brown, slightly calcareous; sand is very fine to medium; some marly areas; light grayish-brown below 255 ft	253	257.5
Sand, very fine to medium, some coarse to very coarse with a little gravel	257.5	260
Silty sand to sandy silt, moderately clayey, pale-yellow; sand is very fine to fine	260	262
Sand, very fine to very coarse; silty below 264.7 ft	262	268
Sand, slightly gravelly; fine sand to coarse gravel	268	270
Silt, very sandy, slightly clayey, light greenish-gray; sand is very fine to fine	270	280
Sand, very fine to fine, slightly clayey, slightly silty	280	285
Silt, very clayey, very sandy, brown; sand is very fine to fine	285	287
Sand, gravelly; very fine sand to coarse gravel	287	291
Silty sand to sandy silt, slightly clayey, light brownish-gray and grayish-brown; sand is very fine to medium; light brown and light-gray below 295 ft	291	296
Gravel, sandy; very fine sand to very coarse gravel	296	300.5
Marl, sandy, white; sand is very fine to medium	300.5	305
Sand, very fine to fine, very silty, slightly clayey; in part marly sand	305	325.7
Sand, very fine to coarse, much fine to coarse	325.7	331.5
Silt, very clayey, pale-brown, moderately calcareous	331.5	333
Marl, slightly silty, moderately sandy, white; sand is very fine to medium	333	335.3
Sand, very fine to coarse, with some very coarse sand to fine gravel, slightly silty, slightly clayey	335.3	340
Sandy silt to silty sand, moderately clayey, light gray, moderately calcareous; sand is very fine to medium; light-brown below 340.8 ft	340	344

	Depth, in Feet From	To
16N-54W-31ccc--continued		
Tertiary-Pliocene-Ogallala--continued		
Silt, moderately clayey, slightly sandy, brown	344	348
Sand, gravelly; very fine sand to very coarse gravel	348	355
Sand, very fine to medium, slightly silty; marly below 359.3 ft	355	361.3
Sand, slightly gravelly; very fine sand to coarse gravel, much fine to coarse sand; much re-worked material; in part lime-cemented	361.3	389
Sand, very fine to fine, some medium to coarse, slightly silty; marly below 390 ft; sand is very fine to fine	389	390.8
Sand, very fine to very coarse, some gravel grains; marly below 395 ft	390.8	396.8
Tertiary System:		
Oligocene Series (White River Group)-		
Brule Formation		
Silt to siltstone, slightly clayey, light-brown, slightly calcareous; light yellowish-brown from 410 to 425 ft; slightly sandy below 425 ft; sand is very fine	396.8	450

Test Hole 16N-55W-1aaa
(Field No. 25-B-69)

Location: 14.5 ft south and 525 ft west of NE cor. sec. 1, T. 16 N., R. 55 W.
Ground altitude: 4,835 ft (a)
Depth to water: 216.9 ft (Sept. 1, 1969)

	Depth, in Feet From	To
Quaternary System-undifferentiated		
Pleistocene Series-		
Sandy silt to silty sand, slightly clayey, dark grayish-brown; sand is very fine	0	0.5
Silt, very sandy, slightly clayey, brown; sand is very fine	0.5	4
Tertiary System:		
Pliocene Series-		
Ogallala Formation		
Limestone, sandy, white, in part brown and light-gray; sand is very fine to medium; some interbedded siltstone below 12.8 ft	4	14.8
Siltstone, moderately clayey, slightly sandy, reddish-brown; some interbedded sandstone	14.8	19.5
Silty sand to sandy silt, moderately clayey, brown; sand is very fine to fine; some marly areas below 20 ft	19.5	22.4

	Depth, in Feet	
	From	To
16N-55W-1aaa--continued		
Tertiary-Pliocene-Ogallala--continued		
Silt, moderately clayey, moderately sandy, brown; sand is very fine, in part very fine to fine; reddish-brown and yellowish-brown below 25 ft	22.4	30
Sandstone, very fine- to fine-grained, brown, poorly consolidated; very fine to very coarse with a trace of gravel from 35 to 40 ft	30	41.4
Sandstone, gravelly; very fine sand to fine gravel, silty; in part marly	41.4	45
Silt, marly, slightly sandy, brown; sand is very fine to medium; very sandy below 48.5 ft	45	50
Silty sand to sandy silt, slightly clayey, brown; sand is very fine to medium with some coarse; some marly areas	50	60
Limestone, sandy, white; sand is very fine to medium	60	65
Sandstone, very fine to medium, marly, light-brown, very calcareous, moderately consolidated	65	70
Sand, gravelly; very fine sand to fine gravel, much very fine to medium sand; some marly areas; some coarse gravel below 80 ft	70	86.5
Silt, moderately clayey, moderately sandy, brown; sand is very fine to coarse	86.5	87
Sand, gravelly; fine sand to medium gravel; some marly areas	87	95
Silty sand, sandy silt, moderately clayey, brown and pinkish-gray; sand is very fine to medium; some marly areas	95	113
Limestone, sandy, white; sand is very fine to medium	113	117.5
Silty sand to sandy silt, slightly clayey, light-gray; sand is very fine to medium; some marly areas	117.5	127
Sand, very fine to fine, in part moderately silty; some marly areas; sand is very fine to medium from 140 to 143 ft; sand is very fine to coarse below 145 ft	127	155
Silty sand to sandy silt, marly, brown; sand is very fine to fine	155	164.3
Sand, slightly gravelly; fine sand to coarse gravel; rootlets; silty areas below 165 ft	164.3	170.3
Sand, very fine to medium, very silty	170.3	175
Marl, sandy, white and brown; sand is very fine to medium	175	177.9
Silt, very sandy, marly, white and pale-brown, very calcareous; sand is very fine to medium; very fine to very coarse from 180 to 182.7 ft;		

	Depth, in Feet	
	From	To
16N-55W-1aaa--continued		
Tertiary-Pliocene-Ogallala--continued		
very fine to fine below 182.7 ft	177.9	185
Sand, very fine to fine, slightly silty	185	187.5
Sand, gravelly; very fine sand to coarse gravel, much very fine to medium sand; much coarse sand to medium gravel from 190 to 195 ft	187.5	200
Gravel, sandy; very fine sand to coarse gravel	200	209
Silt, moderately clayey, moderately sandy, gray; marly from 210 to 210.4 ft	209	211.5
Sand, very fine to medium with a trace of coarse to very coarse	211.5	215
Silt, moderately clayey, moderately sandy, light-gray and light brown, moderately calcareous; sand is very fine to fine; marly areas below 220 ft	215	227.5
Sandstone, very fine- to very coarse-grained, marly, light-gray, moderately calcareous, moderately consolidated	227.5	230
Marl, silty, moderately sandy, light-brown and white; sand is very fine to coarse	230	230.9
Limestone, sandy, pinkish-white; sand is very fine to fine	230.9	232.5
Silt, very sandy, slightly clayey, light reddish-brown, slightly calcareous; sand is very fine to fine	232.5	238
Sand, very fine to fine, silty; very fine to medium below 240 ft	238	241.8
Gravel, sandy; very fine sand to coarse gravel	241.8	245
Sand, gravelly; fine sand to coarse gravel, much coarse sand to fine gravel; much medium to coarse sand below 255 ft	245	260
Sand, gravelly; very fine sand to coarse gravel, much coarse sand to medium gravel; silt lens from 264.4 to 264.8; much medium sand to fine gravel below 270 ft	260	275
Gravel, sandy; very fine sand to very coarse gravel; interbedded silt lens below 280 ft	275	285
Sand, gravelly; very fine sand to very coarse gravel, much coarse sand to medium gravel	285	290
Silt, very sandy, slightly clayey, light-brown; sand is very fine to fine	290	292.5
Gravel, sandy; very fine sand to very coarse gravel	292.5	300
Sand, gravelly; very fine sand to very coarse gravel; interbedded silt lenses	300	315
Silty sand to sandy silt, slightly clayey, brown and light-gray; marly below 320 ft; sand is very fine to fine	315	325

	Depth, in Feet	
	From	To
16N-55W-1aaa--continued		
Tertiary-Pliocene-Ogallala--continued		
Silt, very sandy, slightly clayey, light-brown; sand is very fine to fine	325	329.3
Sand, very fine to very coarse, with a little fine gravel, much fine to coarse sand	329.3	331
Clay, moderately silty, slightly sandy, light reddish-brown and light greenish-gray; sand is very fine	331	335.5
Marl, silty, sandy, light-gray; sand is very fine to medium	335.5	336.8
Sand, very fine to very coarse with a trace of fine gravel, much fine to coarse sand	336.8	339
Silt, moderately clayey, light greenish-gray; marly areas	339	340.2
Sand, gravelly; very fine sand to coarse gravel, much fine to coarse sand; interbedded silt lenses	340.2	350
Gravel, sandy; fine sand to very coarse gravel; interbedded silt lenses	350	365
Silt, very sandy, moderately clayey, brown, some light greenish-gray; sand is very fine	365	367
Sand, gravelly; very fine sand to coarse gravel; interbedded silt lenses to 370 ft	367	372
Sandstone, very fine-grained, silty, light-gray, moderately calcareous, well consolidated	372	373
Silt, slightly clayey, slightly sandy, light-brown, slightly calcareous; sand is very fine	373	375
Gravel, sandy; fine sand to very coarse gravel; some interbedded silty sand lenses; some marl below 385 ft	375	390
Sand, gravelly; very fine sand to coarse gravel, much medium sand to fine gravel; interbedded silty sand lenses	390	405
Sand, gravelly; very fine sand to coarse gravel, much fine to coarse sand; much medium to very coarse sand from 410 to 420 ft; in part some interbedded silty sand lenses	405	435
Gravel, sandy; fine sand to very coarse gravel; interbedded silt and marl lenses; much silt below 450 ft	435	455
Sand, gravelly; very fine sand to medium gravel, much medium to coarse sand; some marly areas below 465 ft	455	470
Gravel, sandy; fine sand to very coarse gravel, much very coarse sand to coarse gravel; interbedded silt lenses; below 450 ft, finer textured, some marly areas	470	482.3

	Depth, in Feet	
	From	To
16N-55W-1aaa--continued		
Tertiary-Pliocene-Ogallala--continued		
Silt to siltstone, slightly clayey, light-brown, slightly calcareous	482.3	485
Sand, slightly gravelly; very fine sand to fine gravel, silty	485	487.5
Silt to siltstone, moderately clayey, grayish-brown, slightly calcareous; light-brown below 487.7 ft	487.5	492
Sand, slightly gravelly; fine sand to coarse gravel, much medium to coarse sand; marly and silty below 500 ft	492	508
Tertiary System:		
Oligocene Series (White River Group)-		
Brule Formation		
Silt to siltstone, slightly clayey, light-brown, slightly calcareous; slightly sandy below 520 ft; sand is very fine	508	530

Test Hole 16N-55W-22bbb
(Field No. 8-ANB-70)

Location: 146 ft south and 3 ft east of NW cor. sec. 22, T. 16 N., R. 55 W.
Ground altitude: 4,868.4 ft (a)
Depth to water: 191.4 ft (Oct. 17, 1970)

	Depth, in Feet	
	From	To
Quaternary System-undifferentiated		
Silt, moderately sandy, slightly clayey, dark grayish-brown	0	3.5
Sand, gravelly; very fine sand to medium gravel with a little coarse to very coarse gravel	3.5	10
Gravel, sandy; very fine sand to fine gravel with a trace of medium to coarse gravel	10	15
Gravel, sandy; very fine sand to coarse gravel with a little very coarse gravel; interbedded siltstone lenses; slightly finer-grained from 20 to 30 ft	15	35
Gravel, sandy; very fine sand to medium gravel; coarser-grained from 50 to 55 ft	35	60
Tertiary System:		
Pliocene Series-		
Ogallala Formation		
Clay, moderately silty, light-gray	60	65
Sand, gravelly; very fine sand to fine gravel, with some medium and a trace of coarse gravel; interbedded bentonitic clay lens	65	70
Clay, very sandy, moderately silty, pinkish-gray; sand is very fine to medium;		

	Depth, in Feet	
	From	To
16N-55W-22bbb--continued		
Tertiary-Pliocene-Ogallala--continued		
interbedded limestone and lime-cemented sandstone lenses; light olive-gray below 75 ft	70	80
Limestone to sandstone, pinkish-gray, very calcareous; sand is very fine to medium; interbedded clay lenses; few grained below 85 ft	80	95
Clay, moderately silty, brown; slightly sandy from 100 to 105 ft; sand is very fine to fine	95	111.5
Sand, gravelly; very fine sand to medium gravel-	111.5	115
Sand, gravelly; very fine sand to medium gravel, little coarse gravel; coarser-grained below 120 ft	115	130
Gravel, sandy; very fine sand to fine gravel, some medium, little coarse gravel	130	132.5
Clay, slightly silty, light reddish-brown; some light-gray color below 145 ft	132.5	160
Sand, gravelly; very fine sand to fine gravel, little medium gravel	160	165
Sand, very fine to very coarse, little fine gravel	165	170
Clay, very sandy, slightly silty, light reddish-brown; sand is very fine to very coarse	170	175
Clay, very sandy, in part silty sand, pinkish-gray; sand is very fine to fine	175	185
Clay, very sandy, slightly silty, dark-gray; sand is very fine; some light-brown limy areas below 190 ft	185	195
Sand, very fine to very coarse, very silty	195	200
Clay, moderately sandy, slightly silty, pinkish-gray, some light-brown; moderately calcareous; sand is very fine to fine; interbedded lime-cemented sandstone lenses	200	205
Clay, slightly silty, reddish-brown; limy layer about 211 ft	205	215
Clay, moderately silty, moderately sandy, light-gray; sand is very fine; some limy areas	215	220
Clay, reddish-brown	220	222
Sand, very fine to very coarse, some gravel grains	222	225
Sand, gravelly; very fine sand to fine gravel, a little medium, trace of coarse gravel; slightly coarser-grained below 230 ft; clay lens at 234 ft	225	235
Sandstone, very fine- to fine-grained, light-brown, moderately calcareous, well consolidated; interbedded limy layers	235	241

	Depth, in Feet	
	From	To
16N-55W-22bbb--continued		
Tertiary-Pliocene-Ogallala--continued		
Clay, moderately silty, pinkish-gray; some very fine sand	241	245
Clay, moderately silty, slightly sandy, light olive-gray; sand is very fine; interbedded sandstone lens at 248 ft	245	250
Clay, moderately silty, slightly sandy, pinkish-gray; sand is very fine	250	255
Clay, moderately silty, very sandy, in part sand, pinkish-gray, moderately calcareous; sand is very fine to very coarse with a trace of fine gravel	255	262.2
Sand, very fine to very coarse, little fine gravel; clayey at 266 ft	262.2	270
Clay, moderately sandy, moderately silty, pinkish-gray; sand is very fine to fine; some limy areas	270	275
Clay, moderately silty, light reddish-brown, some limy areas	275	283
Sand, very fine to coarse, some very coarse	283	286
Tertiary System:		
Oligocene Series (White River Group)-		
Brule Formation		
Silt to siltstone, light reddish-brown; slightly calcareous from 290 to 295 ft and below 310 ft	286	320

Test Hole 16N-56W-1aab
(Field No. 16-B-69)

Location: 763 ft west and 43 ft south of NE cor. sec. 1, T. 16 N., R. 56 W.
Ground altitude: 4,878 ft (a)
Depth to water: 168.4 ft (July 28, 1969)

	Depth, in Feet	
	From	To
Quaternary System-undifferentiated		
Silt, moderately sandy, slightly clayey, dark-brown; sand is very fine to fine; grayish-brown, very calcareous below 1.5 ft	0	2
Tertiary System:		
Pliocene Series-		
Ogallala Formation		
Limestone, white, in part sandy; sand is very fine to medium	2	7
Sandstone, very fine- to medium-grained, pinkish-gray and brown, very calcareous, moderately consolidated	7	10.6
Limestone, white; interbedded sandstone lens from 11.2 to 12 ft	10.6	16

	Depth, in Feet	
	From	To
16N-56W-1aab--continued		
Tertiary-Pliocene-Ogallala--continued		
Sand, very fine to very coarse, slightly silty; slightly gravelly below 20 ft; interbedded limestone and silt lenses below 22 ft	16	25
Silt, moderately clayey, moderately sandy, reddish-brown; sand is very fine to medium	25	26.5
Sandstone, gravelly, lime-cemented, pinkish-gray	26.5	28.5
Siltstone, slightly clayey, slightly sandy, pinkish-gray, very calcareous; sand is very fine to coarse	28.5	30
Silt, moderately clayey, brown; moderately sandy below 35 ft; sand is very fine to medium with some gravel grains	30	40
Sand, very fine to coarse with some gravel grains; very fine, moderately silty below 44.9 ft; marly below 45 ft	40	47.2
Limestone, sandy, white; sand is very fine to medium	47.2	48.3
Sand, very fine to coarse, moderately silty; very fine to medium, lime-cemented below 50 ft	48.3	53
Silt, moderately sandy, slightly clayey, light reddish-brown; sand is very fine to fine, in part very fine to medium; pinkish-gray from 54.4 to 55 ft; light-brown below 55 ft	53	57.5
Silty sand to sandy silt, slightly clayey, light reddish-brown; sand is very fine to medium; pinkish-gray, slightly calcareous below 60 ft	57.5	65
Silt, moderately clayey, moderately sandy, brown; sand is very fine; marly areas	65	68.8
Sand, very fine to fine, moderately silty	68.8	69.3
Silt to siltstone, moderately sandy, slightly clayey, light-brown; sand is very fine to fine	69.3	69.7
Sand, very fine to fine, silty; interbedded clay and marl lenses	69.7	72.8
Silt, moderately clayey, moderately sandy, pink, slightly calcareous; pale-brown, moderately calcareous below 74.2 ft	72.8	76
Silty sand to sandy silt, slightly clayey, brown; sand is very fine to medium; pink from 77.3 to 77.9 ft; pinkish-gray below 80 ft	76	83.6
Silt, moderately sandy, slightly clayey, pinkish-gray; sand is very fine to fine; pale-brown from 85 to 87 ft; reddish-yellow from 87 to 87.3 ft; yellowish-brown below 87.3 ft	83.6	90

	Depth, in Feet	
	From	To
16N-56W-1aab--continued		
Tertiary-Pliocene-Ogallala--continued		
Sand, very fine, moderately silty	90	91.6
Gravel, sandy; fine sand to medium gravel; fine sand to coarse gravel below 105 ft	91.6	114.5
Silt, very clayey, light-brown	114.5	118.5
Sand, very fine to fine, slightly clayey, light reddish-brown; sand is very fine to fine; marly below 122.2 ft; sand is very fine to medium	118.5	123.5
Silt, moderately sandy, slightly clayey, reddish-brown; sand is very fine to fine; light-brown below 125 ft	123.5	130.5
Sand, slightly gravelly; very fine sand to medium gravel, much very fine to medium sand	130.5	140
Gravel, sandy; fine sand to very coarse gravel,much medium sand to coarse gravel	140	152.8
Sandy silt to silty sand, slightly clayey, light-brown; sand is very fine to fine; some pink below 155 ft	152.8	156
Silt, moderately clayey, reddish-brown; very clayey, marly, pinkish-white below 158.3 ft	156	158.4
Silty sand to sandy silt, slightly clayey, light-brown; sand is very fine to medium; in part pinkish-gray below 160 ft; marly below 163 ft; sand is very fine to very coarse	158.4	164
Silt, moderately sandy, slightly clayey, pale-brown, slightly calcareous; sand is very fine; some pinkish-gray below 165 ft	164	170
Sand, very fine to fine, slightly silty, slightly clayey; sand is very fine to coarse below 171.8 ft	170	173
Sand, gravelly; very fine sand to medium gravel, much very fine to very coarse sand; much fine sand to medium gravel below 175 ft	173	179
Silt, moderately sandy, slightly clayey, brown; sand is very fine to fine; very sandy from 185 to 190 ft; brownish-gray below 190 ft	179	193.5
Gravel, sandy; very fine sand to medium gravel, much very coarse sand to medium gravel; very fine sand to medium gravel from 195 to 200 ft; coarse sand to medium gravel below 200 ft	193.5	205
Gravel, sandy; very fine sand to very coarse gravel, much very coarse sand to coarse gravel	205	235

	Depth, in Feet	
	From	To
16N-56W-1aab--continued		
Tertiary-Pliocene-Ogallala--continued		
Gravel, sandy; fine sand to fine gravel; medium sand to medium gravel below 240 ft; some interbedded clayey silt lenses	235	245
Sand, slightly gravelly; very fine sand to fine gravel, much very fine to coarse sand	245	256
Marl, pinkish-gray	256	258
Silt, moderately clayey, light-brown; slightly clayey, slightly sandy, below 260 ft, sand is very fine; light brownish-gray below 263 ft	258	270
Sandy silt to silty sand, slightly clayey, light-brown; sand is very fine	270	277.5
Gravel, sandy; very fine sand to very coarse gravel, much fine to coarse gravel; interbedded clay lenses below 285 ft	277.5	301.3
Silt, moderately clayey, light greenish-gray and light-brown	301.3	305
Silty sand to sandy silt, slightly clayey, light-gray; sand is very fine to medium; marly areas	305	309.2
Gravel, sandy; very fine sand to very coarse gravel; clayey silt lens at 315.2 ft	309.2	320
Sand, gravelly; fine sand to fine gravel, much medium sand to fine gravel	320	330
Sand, very fine to fine, moderately silty	330	333
Sand, gravelly; fine sand to fine gravel, much medium sand to fine gravel	333	350
Sand, slightly gravelly; fine sand to fine gravel, much medium to very coarse sand; medium sand to medium gravel from 365 to 370 ft; medium sand to coarse gravel below 370 ft; some interbedded silty sand lenses	350	375
Sand, fine to very coarse with a trace of fine gravel, much medium to very coarse sand	375	385
Sand, slightly gravelly; fine sand to coarse gravel, much medium to very coarse sand; fine to very coarse sand from 390 to 395 ft; fine to coarse sand below 395 ft	385	399.9
Marl, sandy, white	399.9	400.6
Sand, gravelly; fine sand to fine gravel, much coarse sand to fine gravel; interbedded silty sand lens below 400.6 ft	400.6	405
Sand, slightly gravelly; fine sand to fine gravel, much medium to very coarse sand	405	410.6
Silt, moderately sandy, slightly clayey, brown, marly; sand is very fine	410.6	414.8
Sand, fine to very coarse with a trace of fine gravel	414.8	429.5

	Depth, in Feet	
	From	To
16N-56W-1aab--continued		
Tertiary-Pliocene-Ogallala--continued		
Gravel, sandy; very fine sand to very coarse gravel, marly	429.5	431
Tertiary System		
Miocene Series ?		
Arikaree Group ?		
Silty sand to sandy silt, slightly clayey, brown; sand is very fine to fine; light-gray and marly below 440 ft	431	445
Silt, moderately sandy, slightly clayey, light-gray, slightly calcareous; sand is very fine	445	450.5
Silt, moderately clayey, light-green; marly to 453.3 ft	450.5	454
Sandstone, very fine- to fine-grained, silty, light greenish-gray, moderately consolidated; some volcanic ash; some marly areas; interbedded siltstone lenses	454	485
Siltstone, slightly clayey, sandy, light-gray; sand is very fine; interbedded sandstone lenses	485	490
Silt, very sandy, slightly clayey, pale-green, slightly calcareous; sand is very fine	490	491.5
Sand, very fine, slightly silty	491.5	494
Tertiary System:		
Oligocene Series (White River Group)-		
Brule Formation		
Silt, slightly clayey, slightly sandy, grayish-brown; sand is very fine; light-gray from 495 to 502 ft; slightly calcareous, light brownish-gray below 502 ft	494	502.5
Silt, moderately clayey, slightly sandy, pale-brown, slightly calcareous; sand is very fine	502.5	520

Test Hole 16N-56W-6bab
(Field No. 15-B-69)

Location: 1,448 ft east and 11 ft south of NW cor. sec. 6, T. 16 N., R. 56 W.
Ground altitude: 5,033 ft (a)
Depth to water: 215.7 ft (July 28, 1969)

	Depth, in Feet	
	From	To
Quaternary System-undifferentiated		
No sample	0	0.5
Sand, very fine to fine, moderately silty	0.5	1.5
Silt, moderately clayey, slightly sandy, dark reddish-gray; very clayey, dark reddish-brown below 2 ft	1.5	4.5

	Depth, in Feet From	To
16N-56W-6bab--continued		
Tertiary System:		
Pliocene Series-		
Ogallala Formation		
Sandy silt to silty sand, slightly clayey, brown to light grayish-brown, slightly calcareous; sand is very fine to fine; light olive-gray below 5 ft	4.5	6.1
Limestone, sandy, silty, pinkish-gray; sand is very fine to fine; interbedded sandstone lenses	6.1	15
Sandstone, very fine- to very coarse-grained, pinkish-gray, very calcareous, moderately consolidated; some gravel grains; principally very fine to fine from 34.4 to 35 ft	15	40
Gravel, sandy; very fine sand to very coarse gravel	40	50
Sand, very fine to very coarse, slightly clayey	50	52.5
Limestone, sandy, pink; sand is very fine to very coarse	52.5	54.5
Silt, moderately clayey, moderately sandy, reddish-brown; sand is very fine to coarse; some marly areas; yellowish-red below 60 ft	54.5	61.3
Sand, very fine to medium, moderately silty; slightly clayey	61.3	61.8
Silt, moderately sandy, slightly clayey, reddish-brown, slightly calcareous	61.8	65
Sandy silt, slightly clayey, light reddish-brown; sand is very fine to very coarse; marly areas below 69 ft; brown below 70 ft	65	73.8
Sand, gravelly; fine sand to very coarse gravel, much medium sand to medium gravel; marly areas	73.8	80
Gravel, sandy; fine sand to coarse gravel, much coarse sand to medium gravel	80	90.9
Sand, very fine to medium, slightly silty	90.9	95.5
Silt, moderately sandy, slightly clayey, yellowish-red and reddish-brown; sand is very fine	95.5	100
Silty sand to sandy silt, slightly clayey, reddish-brown; sand is very fine; light brown below 105 ft	100	110.3
Sand, gravelly; very fine sand to very coarse gravel, much coarse sand to medium gravel	110.3	175.6
Silty sand to sandy silt, slightly clayey, light-brown; sand is very fine to medium, much very fine	175.6	191

	Depth, in Feet	
	From	To
16N-56W-6bab--continued		
Tertiary-Pliocene-Ogallala--continued		
Sand, very fine to medium, moderately clayey -	191	195
Silt, moderately clayey, slightly sandy, brown; sand is very fine ----------	195	203
Sand, gravelly; fine sand to fine gravel; coarse sand to fine gravel below 205 ft -----	203	209.5
Marl, silty, sandy, pinkish-white ----------	209.5	209.6
Silt, slightly clayey, slightly sandy, reddish-yellow; sand is very fine; reddish-brown below 210 ft ----------	209.6	212
Sand, very fine to medium, moderately clayey, slightly silty ----------	212	215
Sand, slightly gravelly; very fine sand to fine gravel, much medium sand to fine gravel ----------	215	232
Silt, slightly clayey, slightly sandy, brown; sand is very fine to fine; very sandy below 235 ft ----------	232	243.4
Marl, silty, slightly sandy, light-gray -------	243.4	243.5
Silt, moderately clayey, slightly sandy, reddish-brown and brown; sand is very fine --	243.5	250.7
Silty sand to sandy silt, slightly clayey, brown; sand is very fine to fine; some coarse below 267.8 ft ----------	250.7	267.8
Sand, gravelly; medium sand to medium gravel --	267.8	269.5
Silt, moderately clayey, moderately sandy, brown; sand is very fine to medium ----------	269.5	271
Sand, gravelly; medium sand to medium gravel, much medium to very coarse sand ----------	271	273
Silt, very sandy, moderately clayey, brown; sand is very fine ----------	273	276.5
Sand, gravelly; fine sand to medium gravel, much medium sand to medium gravel ----------	276.5	289
Marl, sandy to gravelly, white ----------	289	292
Silt, very sandy, slightly clayey, reddish-brown, moderately calcareous; sand is very fine to fine ----------	292	295
Sand, slightly gravelly; fine sand to fine gravel, much fine to very coarse sand -------	295	298
Silt, moderately sandy, moderately clayey, brown; sand is very fine to medium ----------	298	302
Sand, very fine to coarse, slightly silty -----	302	304
Silt, very sandy, moderately clayey, pinkish-gray, slightly calcareous ----------	304	306.5
Silt, very clayey, very sandy, pale-olive; sand is very fine to fine ----------	306.5	310
Sand, very fine to fine, slightly silty; a few rootlets below 315 ft ----------	310	322.2

	Depth, in Feet	
	From	To
16N-56W-6bab--continued		
Tertiary System:		
Miocene Series ?		
Arikaree Group ?		
Silty sand to sandy silt, slightly clayey, brown; sand is very fine to fine; marly from 326.5 to 328.5 ft. and below 340 ft	322.2	355
Clay, silty, sandy, pink and light brown	355	357.8
Silty sand to sandy silt, slightly clayey, brown; sand is very fine to fine	357.8	361.5
Silty sand to sandy silt, marly, pinkish-white; sand is very fine to fine	361.5	365
Silty sand to sandy silt, slightly clayey, brown, some pinkish-gray; sand is very fine to fine; some marly areas; some interbedded clay and siltstone lenses	365	435
Sand, very fine to fine, slightly silty, in part slightly clayey	435	458.9
Sand, very fine to fine, marly, silty; some claystone grains	458.9	470
Sand, very fine to fine, slightly silty	470	485
Silt, moderately clayey, moderately sandy, pink; sand is very fine	485	490
Sand, very fine to fine, slightly silty; claystone lens 495 to 495.9 ft; marly from 511.5 to 515.9 ft; sand is very fine to coarse below 515.9 ft	490	520
Silt, very clayey, very sandy, pale-brown to light-gray, slightly calcareous; sand is very fine to fine	520	524
Silt, very clayey, pale-yellow to light-gray, slightly calcareous	524	525
Silt, moderately clayey, moderately sandy, light-gray, slightly calcareous; sand is very fine to fine	525	527
Silt, very clayey, moderately sandy, light brownish-gray and light greenish-gray, slightly calcareous; sand is very fine to fine	527	532
Marl, sandy, white; sand is very fine	532	532.2
Sandy silt to silty sand, slightly clayey, light-gray; light olive-gray below 538.5 ft	532.2	541
Tertiary System:		
Oligocene Series (White River Group)-		
Chadron Formation		
Silt, moderately clayey, slightly sandy, pale-green, slightly calcareous; sand is very fine	541	547.5
Silt, slightly clayey, light greenish-gray and olive-gray, slightly calcareous	547.5	550

	Depth, in Feet	
	From	To
16N-56W-6bab--continued		
Tertiary-Oligocene-Chadron--continued		
Silt, moderately clayey, slightly sandy, pale-green, moderately calcareous; sand is very fine; light greenish-gray below 558 ft ------	550	560
Silt, very clayey, marly, white ----------	560	561.2
Sand, very fine, moderately silty ----------	561.2	561.3
Silt to siltstone, slightly clayey, sandy, bluish-gray, slightly calcareous; sand is very fine ----------	561.3	573
Silt, very sandy, slightly clayey, bluish-gray, moderately calcareous; slightly calcareous below 580 ft ----------	573	585
Sand, very fine, very silty ----------	585	586.6
Silt, moderately clayey, slightly sandy, bluish-gray; sand is very fine ----------	586.6	590

Test Hole 16N-56W-22bbb
(Field No. 9-ANB-70)

Location: 74.5 ft south and 72.5 ft east of NW cor. sec. 22, T. 16 N., R. 56 W.
Ground altitude: 4,940.6 ft (a)
Depth to water: 200.6 ft (Oct. 17, 1970)

	Depth, in Feet	
	From	To
Quaternary System-undifferentiated		
Silt, very sandy, slightly clayey, dark grayish-brown ----------	0	0.5
Tertiary System:		
Pliocene Series-		
Ogallala Formation		
Sandstone, gravelly; very fine sand to fine gravel, well consolidated ----------	0.5	5
Limestone, sandy, pinkish-white; sand is very fine to fine; interbedded sandstone lenses --	5	10
Sandstone, very fine- to fine-grained, some medium to coarse with a trace of very coarse, dark-brown, very calcareous, well consolidated; interbedded limestone lenses --	10	15
Sandstone, gravelly; very fine sand to fine gravel, some medium gravel, light-brown; very calcareous, well consolidated; poorly consolidated, coarser-grained below 20 ft ----------	15	36
Sand, very fine to very coarse, very silty ----	36	42
Limestone, sandy, pinkish-white; sand is very fine to medium, some coarse to very coarse --	42	48
Silt, very sandy, moderately clayey, brown, moderately calcareous; sand is very fine to medium; some limy areas ----------	48	55

	Depth, in Feet	
	From	To
16N-56W-22bbb--continued		
Tertiary-Pliocene-Ogallala--continued		
Silt to siltstone, brown, limy areas	55	60
Clay, moderately silty, reddish-brown	60	70
Sand, very fine to very coarse, trace of fine gravel; a little fine to medium gravel below 80 ft	70	85
Gravel, sandy; very fine sand to fine gravel, some medium with a trace of coarse gravel	85	100
Sand, gravelly; very fine sand to fine gravel, some medium gravel	100	113
Clay, moderately silty, micaceous, brown	113	120
Clay, very sandy, moderately silty, pink; sand is very fine to fine, some medium	120	125
Clay, moderately silty, micaceous, light-brown, some bentonite, some very fine sand	125	130
Clay, moderately silty, moderately sandy, pinkish-gray; sand is very fine, some fine; very sandy below 135 ft	130	150
Clay, moderately silty, slightly sandy, light reddish-brown, slightly calcareous; sand is very fine; interbedded sandstone lens 156 ft	150	160
Clay, moderately sandy, slightly silty, light-brown, moderately calcareous; sand is very fine to fine; some limy areas	160	170
Clay, slightly silty, reddish-brown, some very fine sand; slightly calcareous, moderately sandy below 175 ft	170	182
Sand, fine to very coarse with a trace of fine gravel	182	185
Sand, gravelly; very fine sand to fine gravel with a little medium gravel	185	190
Clay, slightly silty, light reddish brown; moderately sandy to in part very sandy below 195 ft; sand is very fine to fine with some coarse grains	190	226
Sand, very fine to very coarse with a little fine gravel	226	230
Sand, gravelly; very fine sand to fine gravel with a little medium gravel; clayey below 234 ft	230	236
Gravel, sandy; very fine sand to fine gravel, with some medium gravel	236	240
Sand, gravelly; very fine sand to fine gravel with a trace of medium gravel	240	247
Silt, very sandy, moderately clayey, pink; sand is very fine	247	265
Clay, very sandy, slightly silty, pinkish-gray; sand is very fine to fine	265	275
Clay, very sandy, moderately silty, pale-brown with pink tint; sand is very fine to fine	275	279

	Depth, in Feet	
	From	To
16N-56W-22bbb--continued		
Tertiary-Pliocene-Ogallala--continued		
Sand, very fine to very coarse with a trace of fine gravel	279	285
Sand, slightly gravelly, very fine sand to fine gravel with a trace of medium gravel	285	295
Gravel, sandy; very fine sand to medium gravel with some coarse gravel	295	302
Silty sand to sandy silt, moderately clayey, pinkish-gray; sand is very fine to fine, some medium	302	315
Clay, very sandy, slightly silty, pinkish-gray, very calcareous; sand is very fine to fine; interbedded silty sandstone; marly areas below 325 ft	315	345
Sand, very fine to medium, moderately silty	345	350
Clay, very sandy, slightly silty, in part very silty, light-brown, very calcareous; sand is very fine to fine with some medium	350	360
Sand, very fine to medium, some sandstone to siltstone grains; silty below 375 ft	360	380
Sandstone, very fine- to fine-grained, slightly silty, olive-gray	380	390
Clay, moderately silty, moderately sandy, pinkish-gray, moderately calcareous	390	395
Sand, very fine to very coarse	395	400
Sand, slightly gravelly; very fine sand to fine gravel	400	406
Clay, moderately silty, pale-yellow	406	410
Sand, slightly gravelly; very fine sand to fine gravel	410	415
Silt to siltstone, slightly clayey, light olive-gray, some interbedded silty sandstone	415	420
Sand, very fine to coarse with a little very coarse; some marly areas below 425 ft	420	430
Sand, slightly gravelly; very fine sand to fine gravel with some medium gravel, many rounded limestone grains	430	439
Silty sand to sandy silt, slightly clayey, light-brown; sand is very fine to fine; interbedded limy layers	439	450
Sand, very fine to medium; moderately silty below 455 ft	450	460
Silty sand to sandy silt, slightly clayey, light-brown; sand is very fine to fine with some medium to coarse	460	465
Sandstone, very fine- to fine-grained, moderately silty, light-brown, well consolidated	465	475
Clay, moderately silty, light-olive to gray, slightly calcareous;	475	480

	Depth, in Feet From	To
16N-56W-22bbb--continued		
Tertiary-Pliocene-Ogallala--continued		
Clay, very sandy, moderately silty, light-gray, moderately calcareous; sand is very fine ----	480	485
Sandstone, very fine- to fine-grained, moderately silty, light-gray, poorly consolidated; light-brown below 490 ft ----------	485	500
Clay, very sandy, moderately silty, light-gray, very calcareous; sand is very fine to fine; some interbedded silty sandstone; pale yellow from 510 to 515 ft; pale-olive from 515 to 520 ft ----------	500	525
Clay, moderately silty, light-gray, some interbedded sandstone and siltstone lenses --	525	530
Tertiary System:		
Oligocene Series (White River Group)-		
Brule Formation		
Clay, silty to siltstone, light-gray with pink tint; light brownish-gray below 535 ft ------	530	540
Silt to siltstone, slightly clayey, light-brown, thin limy lenses ----------	540	545
Silt to siltstone, slightly clayey, pinkish-gray, moderately calcareous, some very fine sand ----------	545	550
Silt to siltstone, slightly clayey, light brownish-gray, moderately calcareous, some very fine to fine sand ----------	550	555
Silt to siltstone, slightly clayey, light brown to gray, bluish-gray and dark-gray, some sandstone ----------	555	560

Test Hole 16N-57W-15ccc
(Field No. 10-ANB-70)

Location: 55 ft north and 28 ft west of SW cor. sec. 15, T. 16 N., R. 57 W.
Ground Altitude: 5,096.6 ft (a)
Depth to water unknown; Test Hole caved about 200 ft (Oct. 17, 1970)

	Depth, in Feet From	To
Quaternary System-undifferentiated		
Silt, slightly clayey, dark grayish-brown -----	0	0.6
Tertiary System:		
Pliocene Series-		
Ogallala Formation		
Limestone, sandy, pinkish-gray to light gray; sand is very fine to fine; interbedded silty sandstone lenses below 5 ft; sand is very fine to coarse; some very coarse below 10 ft ----------	0.6	15

	Depth, in Feet	
	From	To
16N-57W-15ccc--continued		
Tertiary-Pliocene-Ogallala--continued		
Sandstone, very fine- to medium-grained, some coarse to very coarse, moderately silty, brown, slightly calcareous, well consolidated; interbedded limestone lenses ---------	15	20
Sandstone to limestone, very fine- to coarse-grained, some very coarse, moderately silty, pinkish-gray, very calcareous, well consolidated; trace of fine gravel below 25 ft -----	20	30
Sandstone, very fine- to very coarse-grained, rare fine to coarse gravel, moderately silty, brown, very calcareous, well consolidated ----------	30	35
Sandstone, gravelly; very fine sand to medium gravel, a little coarse to very coarse gravel, moderately silty, brown; interbedded limestone lenses ----------	35	40
Gravel, sandy; very fine sand to very coarse gravel, a few pebbles; interbedded sandstone lenses ----------	40	60
Sandstone, gravelly; very fine sand to very coarse gravel, moderately silty, brown, moderately consolidated; below 65 ft, very fine sand to medium gravel with some coarse gravel, brown to pinkish-gray; interbedded clay lenses below 70 ft ----------	60	75
Clay, sandy to gravelly, moderately silty, pinkish-gray, moderately calcareous, very fine sand to medium gravel, some coarse gravel; interbedded limestone and sandstone lenses ----------	75	80
Sandstone, gravelly; very fine sand to medium gravel, moderately silty, brown to pinkish-gray, poorly consolidated --------	80	85
Gravel, sandy; very fine sand to medium gravel; interbedded sandstone lenses --------	85	90
Sandstone, gravelly; very fine sand to medium gravel, little coarse gravel, moderately silty, light-brown to light-gray, moderately consolidated ----------	90	95
Sandstone, very fine- to fine-grained, slightly silty, light-gray to pinkish-gray, moderately calcareous, well consolidated; interbedded limestone and clay lenses; sandy to gravelly below 100 ft ----------	95	105
Clay, very sandy, silty, brown, slightly calcareous; sand is very fine to medium; interbedded sandstone lenses; finer-grained below 110 ft ----------	105	130

	Depth, in Feet	
	From	To
16N-57W-15ccc--continued		
Tertiary-Pliocene-Ogallala--continued		
Clay, very sandy, slightly silty, dark reddish-brown; sand is very fine to fine with some coarser grains	130	135
Clay, very sandy, slightly silty, light-brown; sand is very fine to fine; some interbedded sandstone lenses	135	145
Clay, moderately silty, moderately sandy, pinkish-gray, slightly calcareous; sand is very fine to fine; interbedded sandstone lenses; some bentonite; light reddish-brown below 150 ft	145	155
Silty sand to sandy silt, slightly clayey, pink; sand is very fine to medium with a trace of coarse; below 160 ft, sand is very fine to very coarse with a little fine to medium gravel	155	165
Sand, very fine to very coarse with a trace of fine gravel, interbedded sandy clay lenses; a little medium gravel below 170 ft	165	175
Sand, gravelly; very fine sand to fine gravel with some medium gravel; interbedded clay lenses; very fine sand to medium gravel with a trace of coarse gravel below 180 ft	175	185
Sand, gravelly; very fine sand to fine gravel with a trace of medium to coarse gravel; some clay lenses below 198.6 ft	185	206
Clay, moderately silty, moderately sandy, brown; sand is very fine to fine; some gravel grains below 209 ft	206	212
Sand, very fine to very coarse with a little fine gravel	212	217
Clay, moderately silty, reddish-brown; slightly sandy, reddish-yellow below 220 ft; sand is very fine	217	230
Clay, moderately silty, moderately sandy, light reddish-brown; sand is very fine to fine; very sandy below 235 ft with some medium sand	230	240
Clay, very sandy, moderately silty, light reddish-brown; sand is very fine to very coarse with a little fine gravel; some limy areas and interbedded sandstone lenses	240	250
Clay, silty, reddish-brown, a little very fine sand	250	255
Clay, moderately silty, moderately sandy, brown, moderately calcareous; very fine to fine sand; interbedded sandstone lenses; below 265 ft, sand is very fine to medium with some coarser grains	255	270

	Depth, in Feet	
	From	To
16N-57W-15ccc--continued		
Tertiary-Pliocene-Ogallala--continued		
Clay, moderately silty, sandy to gravelly, light reddish-brown, moderately calcareous; very fine sand to fine gravel with some medium to coarse gravel	270	276
Sand, gravelly; very fine sand to fine gravel, some medium, trace of coarse gravel	276	295
Sand, very fine to coarse, little very coarse	295	297.5
Clay, very sandy, moderately silty, light reddish-brown; sand is very fine to fine; below 305 ft, pink to gray, limy areas and interbedded sandstone lenses	297.5	310
Clay, silty, pale-brown, moderately calcareous; interbedded sand lens about 312 ft	310	315
Sand, gravelly; very fine sand to fine gravel with a trace of medium to coarse gravel; interbedded clay lenses below 320 ft	315	330
Clay, very sandy, moderately silty, marly, pinkish-white to very calcareous; sand is very fine to fine; interbedded sandstone lenses; no marl below 340 ft	330	345
Silty sand to sandy silt, slightly clayey, dark-gray, slightly calcareous; sand is very fine to medium; interbedded sandstone lenses	345	350
Clay, moderately silty, marly, pinkish-white to pinkish-gray, slightly calcareous; interbedded limestone lenses	350	360
Silt, very sandy, moderately clayey, in part marly, pinkish-gray, slightly calcareous; sand is very fine to medium; interbedded sandstone and limestone lenses	360	365
Sand, very silty, sand is very fine to medium with a trace of coarse; clay lens at about 368 ft	365	370
Sand, moderately silty; sand is very fine to medium; interbedded limestone lenses below 380 ft	370	385
Sand, slightly gravelly; principally siltstone to sandstone, very fine sand to fine gravel with some medium gravel; interbedded silty clay lenses below 390 ft	385	392
Clay, very sandy, moderately silty, pinkish-gray; very fine to fine sand with some coarser grains; interbedded sandstone to siltstone lenses below 400 ft	392	405
Sand, slightly gravelly; principally siltstone to sandstone, limestone, very fine sand to fine gravel, a little medium gravel; interbedded clay lenses	405	425

	Depth, in Feet	
	From	To
16N-57W-15ccc--continued		
Tertiary-Pliocene-Ogallala--continued		
Sand, slightly silty; sand is very fine to medium, much fine	425	430
Sand, very fine to medium, some coarse; interbedded clay lenses below 439 ft; trace of coarse, some consolidation below 445 ft	430	450
Sandstone, very fine- to fine-grained, moderately silty, light-gray, poorly consolidated; from 455 to 460 ft sand is very fine to coarse with some limy areas	450	465
Silty sand to sandy silt, slightly clayey, brown; sand is very fine to fine; interbedded sandstone lenses	465	480
Sandstone, very fine- to fine-grained, some medium, slightly silty, light-gray, moderately calcareous, poorly consolidated; some rootlets; below 485 ft, some light-brown color, moderately consolidated	480	490
Sandstone, very fine- to medium-grained, slightly silty, light-olive, poorly consolidated; some rootlets	490	500
Silty sand to sandy silt, slightly clayey, pinkish-gray; sand is very fine to medium; some rootlets; some consolidation	500	505
Sandstone, very fine- to fine-grained, slightly silty, pale-brown, moderately consolidated; in part some rootlets, some marly areas, some siltstone fragments; poorly consolidated and slightly calcareous below 520 ft	505	545
Siltstone, slightly clayey, light-brown, slightly calcareous; pinkish-gray below 560 ft	545	565
Siltstone to sandstone, slightly clayey, brown, slightly calcareous; sand is very fine	565	575
Sandstone, very fine- to fine-grained, brown, slightly calcareous, moderately consolidated, some siltstone grains	575	580
Silt, very sandy, moderately clayey, light yellow-brown, slightly calcareous	580	585
Sandstone, very fine- to fine-grained, moderately silty, brown, slightly calcareous, moderately consolidated; interbedded silt lenses	585	595
Clay, moderately silty, slightly sandy, light brown to pink, slightly calcareous; sand is very fine	595	602.5
Clay, moderately silty, pale-yellow; slightly sandy below 605 ft, sand is very fine; light olive-gray below 610 ft	602.5	614

	Depth, in Feet From	To
16N-57W-15ccc--continued		
Tertiary-Pliocene-Ogallala--continued		
Chert, olive ----------	614	

(Beds below 545 feet may be older than the Ogallala Formation)

Test Hole 16N-57W-36ddd
(Field No. 14-B-69)

Location: 101 ft north and 31 ft west of SE cor. Sec. 36, T. 16 N., R. 57 W.
Ground altitude: 5,003 ft (a)
Depth to water: 242.4 ft (July 28, 1969)

	Depth, in Feet From	To
Quaternary System-undifferentiated		
Silt, moderately sandy, slightly clayey, dark-brown; sand is very fine to medium ----------	0	0.5
Tertiary System:		
Pliocene Series-		
Ogallala Formation		
Sandstone, very fine- to fine-grained, light reddish-brown, slightly calcareous, poorly consolidated ----------	0.5	2
Sand, gravelly; very fine sand to fine gravel -	2	2.8
Siltstone, very sandy, slightly clayey, light-brown and pinkish-gray, moderately calcareous; sand is very fine ----------	2.8	5
Sandstone, very fine- to medium-grained, light reddish-brown, poorly consolidated ----------	5	6.5
Gravel, sandy; very fine sand to very coarse gravel; interbedded siltstone lens from 10 to 10.5 ft ----------	6.5	15
Sand, very fine to medium, some coarse --------	15	15.6
Silt, moderately clayey, moderately sandy, pinkish-gray, moderately calcareous; sand is very fine to medium ----------	15.6	17.5
Gravel, sandy; very fine sand to very coarse gravel; interbedded silt lens 19.8 to 20 ft -	17.5	22.8
Sand, very fine to fine, slightly silty -------	22.8	32.5
Silt, moderately sandy, slightly clayey, reddish-brown and pink, slightly calcareous; sand is very fine to fine ----------	32.5	35.2
Gravel, sandy; very fine sand to very coarse gravel ----------	35.2	47.5
Marl, silty, sandy, pinkish-white ----------	47.5	50
Silty sand to sandy silt, slightly clayey, reddish-brown and pink; sand is very fine to fine ----------	50	53
Silty sand to sandy silt, slightly clayey, light-brown and light reddish-yellow; sand is very fine to coarse ----------	53	64

	Depth, in Feet	
	From	To
16N-57W-36ddd--continued		
Tertiary-Pliocene-Ogallala--continued		
Silt, moderately clayey, slightly sandy, yellowish-red, reddish-brown and pink; sand is very fine to coarse; some marly areas	64	67
Silty sand to sandy silt, slightly clayey, pinkish-white, reddish-yellow, and is very fine to coarse; some marly areas	67	78
Sand, slightly gravelly; very fine sand to medium gravel	78	85
Clay, silty, sandy, reddish-brown	85	89.5
Sandy silt to silty sand, slightly clayey, reddish-brown and pinkish-white; sand is very coarse from 94.8 to 95 ft; very fine to fine below 95 ft	89.5	100
Silty sand to sandy silt, slightly clayey, light reddish-brown, light-brown, and pink, slightly calcareous; sand is very fine to very coarse	100	115
Sand, slightly gravelly; very fine sand to fine gravel, slightly silty	115	117.2
Silt, slightly clayey, slightly sandy, reddish-brown, slightly calcareous; sand is very fine to coarse	117.2	126.5
Silt, very sandy, slightly clayey, light-brown, slightly calcareous; sand is very fine to fine; very clayey below 132 ft; light reddish-brown, noncalcareous below 136 ft	126.5	150
Sand, very fine to medium, slightly silty, slightly clayey	150	155
Silty sand to sandy silt, slightly clayey, brown, yellowish-red and pinkish-gray; slightly calcareous below 167.5 ft; sand is very fine to fine	155	180
Silt, slightly clayey, slightly sandy, reddish-brown, brown, some white and pinkish-gray; sand is very fine to fine; in part very sandy; some marly areas	180	229.5
Sand, gravelly; very fine sand to medium gravel	229.5	233.9
Sandy silty to silty sand, slightly clayey, brown; sand is very fine to fine	233.9	237.5
Silt, slightly clayey, slightly sandy, reddish-brown; sand is very fine to fine; in part moderately sandy	237.5	260
Sandy silt to silty sand, slightly clayey, reddish-brown and brown; sand is very fine to coarse	260	270
Sand, very fine to very coarse with a trace of gravel	270	276

	Depth, in Feet	
	From	To
16N-57W-36ddd--continued		
Tertiary-Pliocene-Ogallala--continued		
Silt, slightly clayey, very sandy, pinkish-gray and brown, slightly calcareous; sand is very fine to coarse	276	280
Sand, slightly gravelly; very fine sand to medium gravel; interbedded silty sand lenses	280	295
Sand, gravelly; very fine sand to medium gravel; interbedded silt lenses; very fine sand to coarse gravel below 300 ft	295	315
Sandy silt to silty sand, slightly clayey, pale-brown; sand is very fine to fine	315	320
Silt, moderately sandy, slightly clayey, light-brown; sand is very fine to fine; some marly areas	320	340
Silt, very sandy, slightly clayey, light yellowish-brown; pinkish-white below 350.3 ft; sand is very fine to fine; some marly areas	340	350.8
Silty sand to sandy silt, slightly clayey, light-brown and pinkish-white; sand is very fine to fine; some interbedded marly lenses	350.8	366
Sandstone, very fine-grained, marly, very calcareous, well consolidated	366	374
Tertiary System:		
Miocene Series-		
(Arikaree Group?)-		
Sandy silt to silty sand, slightly clayey, brown, reddish-brown, and pinkish-gray; sand is very fine; interbedded marly lenses	374	390
Sand, very fine, very silty, in part marly; some lime-cemented sandstone below 400 ft	390	405
Sand, very fine; some marl	405	451.8
Silt, moderately sandy, marly, light brownish-gray, light-brown and pinkish-gray; sand is very fine	451.8	461.5
Tertiary System:		
Oligocene Series (White River Group)-		
Brule Formation		
Silt, moderately clayey, pale-brown; moderately calcareous; pinkish-gray from 465 to 470 ft; slightly calcareous from 470 to 482.5 ft	461.5	490

Test Hole 16N-58W-22bbb
(Field No. 11-ANB-70)

Location: 41 ft south and 12 ft east of NW cor. sec. 22, T. 16 N., R. 58 W.
Ground altitude: 5,213 ft (a)
Depth to water: 251.7 ft (Oct. 17, 1970)

	Depth, in Feet	
	From	To
Quaternary System-undifferentiated		
Silt, moderately clayey, dark brownish-gray ---	0	5
Tertiary System:		
Pliocene Series-		
Ogallala Formation		
Sandstone, gravelly; very fine sand to medium gravel; interbedded limestone lens ----------	5	10
Sandstone, very fine- to very coarse-grained, some fine gravel, moderately silty, reddish-brown, well consolidated ----------	10	15
Sandstone, very fine- to very coarse-grained, some fine to medium gravel, moderately silty, pinkish-gray to light-brown, well consolidated, moderately calcareous ----------	15	30
Gravel, sandy; very fine sand to very coarse gravel, some pebbles ----------	30	43
Clay, marly, white ----------	43	44
Sandstone, very fine- to very coarse-grained, moderately silty, brown and reddish-brown, moderately consolidated, moderately calcareous; some interbedded siltstone and limestone lenses; trace of rootlets; some fine-grained gravel ----------	44	70
Sand, gravelly; very fine sand to fine gravel, moderately silty, much coarse sand; some medium to coarse gravel from 75 to 80 ft; a little very coarse gravel below 80 ft -----	70	84
Clay, silty, moderately sandy, brown; some limy areas; sand is very fine to fine; light reddish-brown from 90 to 95 ft --------	84	100
Clay, moderately silty, moderately sandy, light reddish-brown, limy areas; sand is very fine to fine; less sandy below 110 ft --	100	115
Clay, slightly silty, slightly sandy, light reddish-brown; sand is very fine, in part moderately sandy, coarser-grained below 120 ft ----------	115	125
Clay, very sandy, moderately silty, brown; sand is very fine to fine ----------	125	126
Sand, gravelly; very fine sand to fine gravel, some medium gravel ----------	126	129
Clay, very sandy, moderately silty, brown; sand is very fine to very coarse, rare gravel ----------	129	135

	Depth, in Feet	
	From	To
16N-58W-22bbb--continued		
Tertiary-Pliocene-Ogallala--continued		
Clay, very sandy, moderately silty, light reddish-brown; sand is very fine to coarse, a little very coarse	135	140
Clay, very sandy, moderately silty, brown, slightly calcareous; sand is very fine to fine, a little medium; limy areas below 145 ft	140	154
Gravel, sandy; very fine sand to medium gravel with some coarse and a trace of very coarse gravel, much coarse sand	154	160
Sand, slightly gravelly; very fine sand to fine gravel, a little medium with a trace of coarse to very coarse gravel, much coarse sand	160	165
Sand, very fine to very coarse, much medium	165	170
Clay, moderately silty, light reddish-brown	170	180
Sand, gravelly; very fine sand to very coarse gravel	180	182.5
Clay, moderately silty, moderately sandy, light reddish-brown; sand is very fine to fine, in part very sandy below 195 ft; sand is very fine to very coarse	182.5	205
Sand, gravelly; very fine sand to medium gravel with some coarse gravel, much coarse sand; clay layer from 214 to 218 ft	205	215
Gravel, sandy; very fine sand to coarse gravel, little very coarse gravel, much very coarse sand	215	220
Gravel, sandy; very fine sand to fine gravel, little medium to very coarse gravel; much coarse sand; clay layer from 225 to 227 ft; trace of pebbles below 225 ft	220	230
Sand, gravelly; very fine sand to fine gravel, some medium with a trace of coarse gravel; clay layer below 232 ft	230	235
Sand, very fine to very coarse with a little fine gravel, much very coarse sand;	235	244.9
Clay, very sandy, moderately silty, light-brown; sand is very fine	244.9	250
Sandstone, very fine- to fine-grained, moderately silty, light-gray to light brownish-gray, moderately consolidated, very calcareous, limy areas; interbedded limestone lenses	250	260
Sand and gravel; very fine sand to coarse gravel	260	264
Clay, very sandy, moderately silty, light-brown; sand is very fine; interbedded limestone and sandstone lenses	264	278

	Depth, in Feet	
	From	To
16N-58W-22bbb--continued		
Tertiary System:		
Oligocene Series-		
Brule Formation		
Siltstone, slightly clayey, brown, slightly calcareous, limy areas, some very fine sand	278	380

Test Hole 16N-59W-2abb
(Field No. 5-B-69)

Location: About 2,244 ft west and 20 ft south of NE cor. sec. 2, T. 16 N., R. 59 W.
Ground altitude: 5,248 ft (Albin 7.5 minute quadrangle)
Depth to water: 83.6 ft (June 23, 1969)

	Depth, in Feet	
	From	To
Quaternary System-undifferentiated		
No sample	0	2
Silt, moderately sandy, slightly clayey, dark brownish-gray; brown below 2.5 ft; sand is very fine to medium	2	2.7
Tertiary System:		
Pliocene Series-		
Ogallala Formation		
Sand, very fine to very coarse, some gravel grains	2.7	3
Silt, clayey, sandy, pink and light reddish-brown, slightly calcareous; sand is very fine to fine	3	6.4
Siltstone, slightly clayey, pinkish-white, some marly areas	6.4	10
Sand, very fine to medium, silty, some coarse sand to fine gravel below 12 ft	10	22
Gravel, fine to very coarse; some interbedded silt lenses below 25 ft	22	30.5
Sand, very fine to fine, moderately silty; less silt below 34 ft; some medium to very coarse sand	30.5	40
Sand, very fine to very coarse, slightly silty; some fine gravel below 45 ft	40	60
Sand, very fine to medium, much very fine to fine, slightly silty; moderately silty below 75 ft	60	82
Sand, gravelly; very fine sand to very coarse gravel	82	90
Sand, very fine to medium, slightly silty	90	91.5
Gravel, sandy; very fine sand to very coarse gravel; hard layers from 145.4 to 145.5 ft and from 165.5 to 166 ft	91.5	181

	Depth, in Feet	
	From	To
16N-59W-2abb--continued		
Tertiary-Pliocene-Ogallala--continued		
Silt, moderately sandy, slightly clayey, light brown and light yellowish-brown; some interbedded sandstone lenses	181	196
Sand, very fine to fine, very silty; in part silt, very sandy	196	212
Gravel, sandy; fine sand to medium gravel; silty below 215 ft	212	216.5
Silt, moderately sandy, slightly clayey, brown; sand is fine to very coarse with some gravel grains	216.5	226
Sand, very fine to fine, slightly silty; very fine to very coarse with some gravel below 229.3 ft	226	230
Gravel, sandy; very fine sand to very coarse gravel; some interbedded silt lenses	230	255
Silt, slightly clayey, moderately sandy, yellowish-brown, light-gray and brown; in part marly	255	262.5
Silty sand to sandy silt, slightly clayey, light-gray to 262.7 ft; light-brown below 262.7 ft; sand is very fine; marly areas below 262.5 ft; sand is very fine to medium below 265 ft	262.5	275
Sand, very fine to medium, slightly silty	275	280
Sand, very fine to coarse with some very coarse; some silty areas	280	293.5
Sand, gravelly; very fine sand to very coarse gravel; some interbedded silty clay lenses	293.5	321.3
Gravel, sandy; very fine sand to very coarse gravel; some limy areas and interbedded silt lenses	321.3	360
Sand, gravelly; very fine sand to fine gravel, much coarse sand to fine gravel	360	365
Gravel, sandy; very fine sand to very coarse gravel, much coarse sand to fine gravel; some interbedded silt lenses	365	400
Siltstone, slightly clayey, sandy, brown; sand is very fine to medium with some coarse sand to very coarse gravel	400	425
Gravel, sandy; very fine sand to very coarse gravel	425	440.3
Silt to siltstone, slightly clayey, brown	440.3	442.5
Sand, slightly gravelly; very fine sand to fine gravel	442.5	445
Gravel, sandy; very fine sand to very coarse gravel; some interbedded silty sand and siltstone lenses	445	460

	Depth, in Feet From	To
16N-59W-2abb--continued		
Tertiary System:		
Oligocene Series (White River Group)-		
Brule Formation		
Silt to siltstone, slightly clayey, pale-brown, slightly calcareous; some limy areas below 465 ft	460	480

Test Hole 17N-53W-36dcd (Banner County)
(Field No. 35-B-69)

Location: 1,835 ft west and 30 ft north of SE cor. sec. 36, T. 17 N., R. 53 W.
Ground altitude: 4,696 ft (a)
Depth to water unknown; Test Hole caved at 304 ft (Sept. 2, 1969)

	Depth, in Feet From	To
Quaternary System-undifferentiated		
Silt, moderately sandy, slightly clayey, dark-brown; sand is very fine; dark grayish-brown below 1 ft	0	2
Silty sand to sandy silt, slightly clayey, pale-brown, slightly calcareous; sand is very fine to fine; light yellowish-brown below 7 ft	2	9.8
Tertiary System:		
Pliocene Series-		
Ogallala Formation		
Limestone, slightly sandy; white; sand is very fine to medium	9.8	14
Silt, very sandy, slightly clayey, pink, very calcareous; sand is very fine to medium; some marly areas	14	15
Silty sand to sandy silt, slightly clayey, brown, some white; sand is very fine to fine; in part very fine to medium; trace of coarse sand to fine gravel from 16.5 to 17.8 ft; marly areas below 20 ft	15	23
Silt, very sandy, slightly clayey, grayish-brown; pale-brown and light-gray below 25 ft	23	26.8
Silty sand to sandy silt, slightly clayey, brown; sand is very fine to fine with some medium sand to fine gravel; some marly areas-	26.8	33.5
Silt, moderately sandy, slightly clayey, brown, very calcareous; sand is very fine with some coarser grains; some marly areas	33.5	37
Silty sand to sandy silt, slightly clayey, yellowish-red; sand is very fine with a trace of coarse sand to fine gravel	37	41.7

	Depth, in Feet From	To
17N-53W-36dcd--continued		
Tertiary-Pliocene-Ogallala--continued		
Sand, very fine to fine, some marly areas; in part sandstone; some medium sand to coarse gravel below 43.7 ft	41.7	50
Sand, gravelly; very fine sand to coarse gravel	50	52.2
Sand, very fine to medium with some coarse sand to coarse gravel; some marly areas; some consolidation; sand is very fine to fine from 60 to 60.5 ft and below 65 ft	52.2	67
Sand, gravelly; fine sand to coarse gravel, much very coarse sand to fine gravel	67	70
Gravel, sandy; fine sand to coarse gravel, much coarse sand to medium gravel	70	77.2
Silty sand to sandy silt, slightly clayey, light-gray; sand is very fine to fine	77.2	82
Sand, very fine to very coarse with a trace of fine gravel; finer textured below 85 ft	82	95
Sand, very fine to fine with some medium; some interbedded silt lenses from 100 to 105 ft; some coarse sand to fine gravel below 105 ft	95	108.8
Sand, gravelly; very fine sand to coarse gravel, much coarse to very coarse sand; much coarse sand to fine gravel below 110 ft	108.8	125
Silty sand to sandy silt, slightly clayey, light yellowish-brown and pale-brown; sand is very fine to fine with some medium sand to fine gravel; light-brown and white below 129 ft, some marly areas, no fine gravel	125	132.2
Sand, very fine to medium, some coarse sand to fine gravel, moderately silty	132.2	140
Sand, gravelly; very fine sand to medium gravel, much coarse sand to fine gravel	140	152.5
Silty sand to sandy silt, slightly clayey, marly, brown with some light yellow-brown; sand is very fine to medium; some gravel grains from 159.5 to 160 ft; sand is very fine to fine below 166.5 ft	152.5	168
Sand, gravelly; very fine sand to fine gravel, moderately silty, clayey	168	170
Sandstone, very fine- to coarse-grained, slightly silty, brown, moderately calcareous, moderately consolidated; sand is very fine to very coarse below 174.2 ft; slightly clayey below 179 ft	170	180
Sand, gravelly; very fine sand to fine gravel, moderately silty	180	181.5

	Depth, in Feet	
	From	To
17N-53W-36dcd--continued		
Tertiary-Pliocene-Ogallala--continued		
Silty sand to sandy silt, slightly clayey, brown, slightly calcareous; sand is very fine to coarse, in part very fine to medium; marly areas	181.5	188
Sand, very fine to coarse, moderately silty, clayey, marly; in part sand is very fine to medium	188	203.5
Sand, gravelly; very fine sand to medium gravel, much coarse sand to fine gravel	203.5	210
Silt, very sandy, slightly clayey, marly, pinkish-white, moderately calcareous; sand is very fine to coarse; brown from 212 to 215 ft; sand is very fine to medium below 212 ft	210	220
Sand, very fine to medium with some coarse sand to fine gravel, slightly silty	220	224
Sand, slightly gravelly; very fine sand to medium gravel, much medium to very coarse sand, very silty, slightly clayey	224	228
Silty sand to sandy silt, slightly clayey, slightly silty, pale-brown, slightly calcareous; sand is very fine to fine with some medium sand to fine gravel; some marly areas; some rootlets; no gravel below 235 ft	228	236
Silty sand to sandy silt, slightly clayey, slightly silty, light-gray; sand is very fine to fine with some medium to very coarse sand; in part some rootlets and marly areas; pale-brown below 240.7 ft; no very coarse sand below 243 ft	236	250
Sand, gravelly; very fine sand to fine gravel, much coarse to very coarse sand; interbedded silt lenses from 261.5 to 273.5 ft	250	285
Gravel sandy; fine sand to coarse gravel, much very coarse sand to fine gravel	285	287.6
Silt, moderately clayey, moderately sandy, reddish-brown; sand is very fine to fine; light-brown from 290 to 297 ft; light-gray below 297 ft	287.6	298
Silty sand to sandy silt, moderately clayey, light-brown;sand is very fine to fine with some medium sand to coarse gravel; marly areas; no medium to coarse gravel below 305 ft	298	310
Marl, very sandy, slightly silty, white; sand is very fine to fine with some medium sand to fine gravel	310	311.5

	Depth, in Feet From	To
17N-53W-36dcd--continued		
Tertiary-Pliocene-Ogallala--continued		
Silt, moderately clayey, moderately sandy, light reddish-brown; sand is very fine with some coarser sand and gravel grains; some marly areas; brown below 314.5 ft	311.5	315
Sand, gravelly; fine sand to coarse gravel, much coarse sand to fine gravel	315	325
Silty sand to sandy silt, slightly clayey, brown; sand is very fine to medium with some coarser sand and gravel grains	325	330
Sand, very fine to very coarse with some fine to coarse gravel; some silty areas	330	335
Gravel, sandy; very fine sand to coarse gravel; some interbedded silt lenses; marly below 365 ft	335	370
Sand, gravelly; very fine sand to coarse gravel	370	383.5
Tertiary System:		
Oligocene Series (White River Group)-		
Brule Formation		
Silt to siltstone, slightly clayey, brown; slightly calcareous below 420 ft	383.5	450

Test Hole 17N-57W-33ccc
(Field No. 7-B-69)

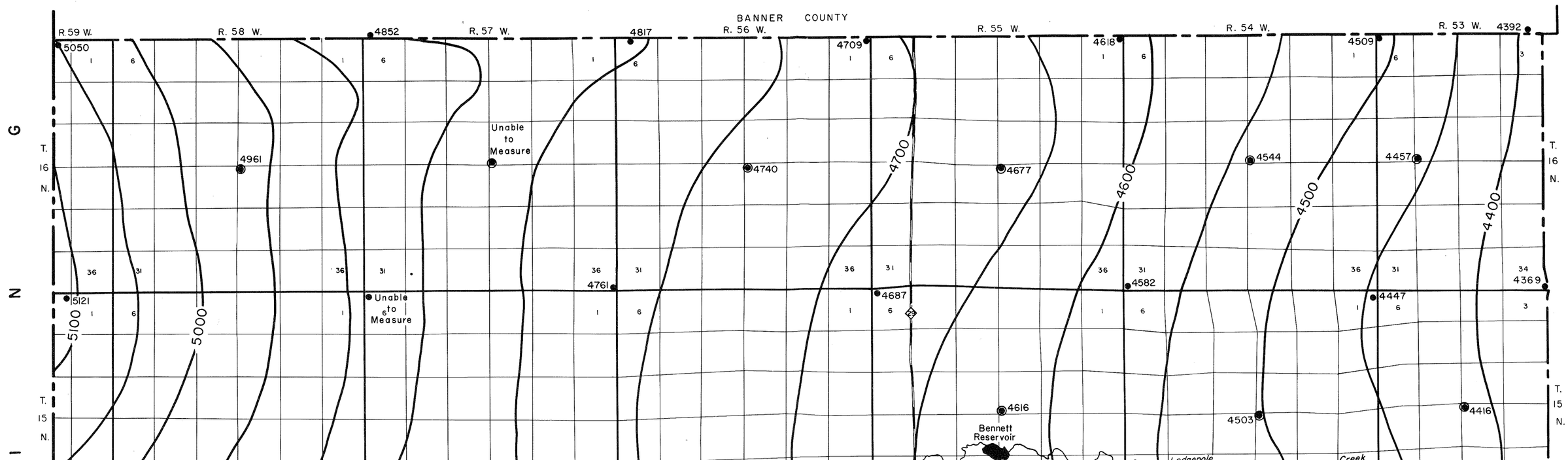
Location: 43 ft north and 73 ft east of SW cor. sec. 33, T. 17 N., R. 57 W.
Ground altitude: 5,127 ft (a)
Depth to water unknown: Test Hole caved at 275 ft (July 28, 1969)

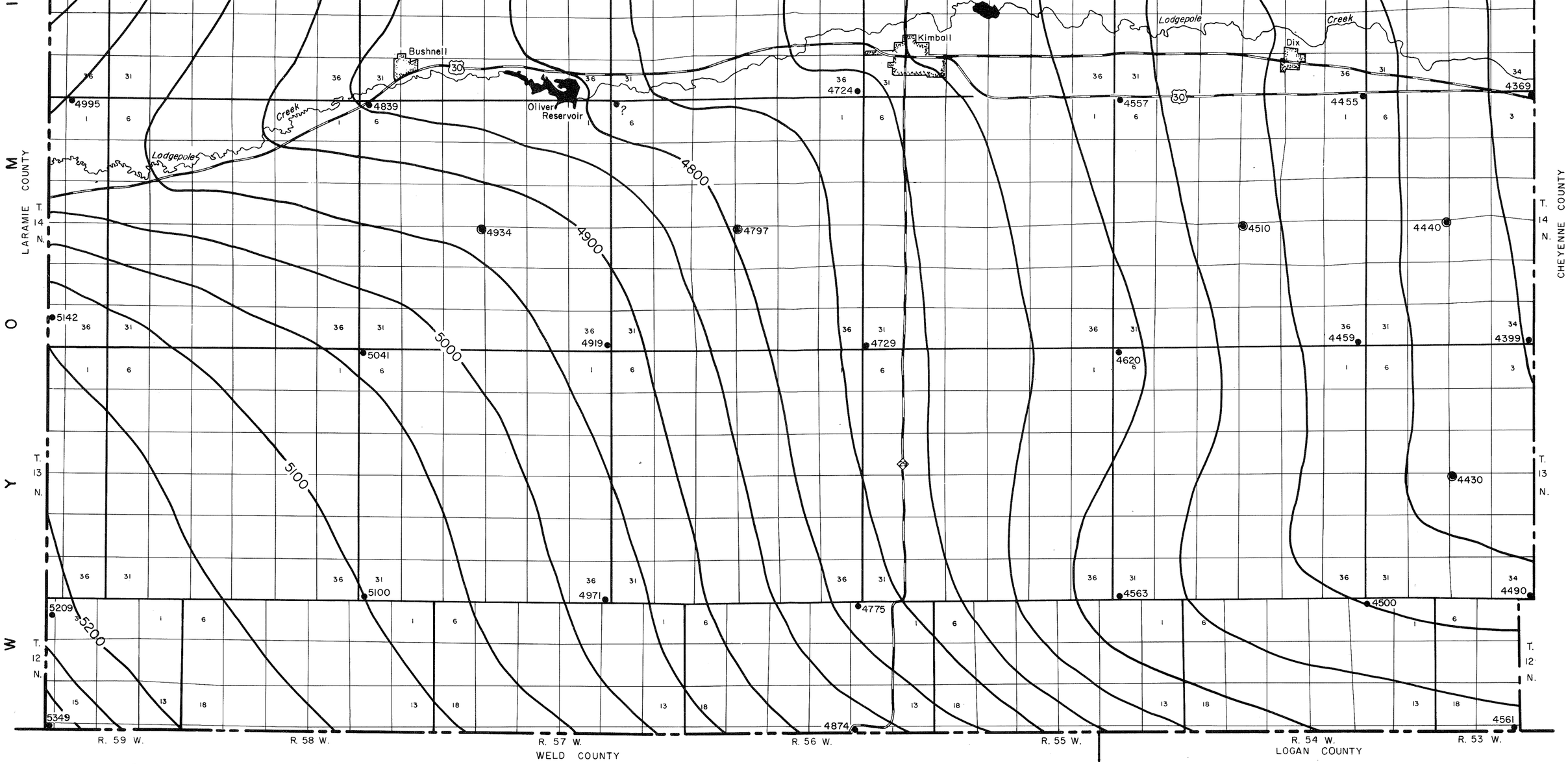
	Depth, in Feet From	To
Quaternary System-undifferentiated		
Silt, very sandy, dark brownish-gray; sand is very fine to fine	0	1
Sand, very fine to medium, trace of coarse, silty	1	2.5
Silt, very sandy, brown; sand is very fine to fine	2.5	2.7
Tertiary System:		
Pliocene Series-		
Ogallala Formation		
Gravel, sandy; very fine sand to fine gravel, principally limestone fragments; silty and marly below 5 ft	2.7	10
Sand, very fine to medium with some coarse sand to fine gravel	10	18.5
Gravel, sandy; very fine sand to very coarse gravel	18.5	20

	Depth, in Feet	
	From	To
17N-57W-33ccc--continued		
Tertiary-Pliocene-Ogallala--continued		
Sand, gravelly; very fine sand to medium gravel	20	28
Silty sand to sandy silt, slightly clayey, reddish-yellow and brown; sand is very fine to coarse, in part gravelly	28	41.5
Gravel, sandy; coarse sand to very coarse gravel	41.5	61.2
Clay, slightly silty, sandy, brown; sand is very fine to medium; a gravel lens from 68 to 69 ft	61.2	70
Silty sand to sandy silt, slightly clayey, brown and yellowish-red; sand is very fine to very coarse; very clayey from 72.5 to 73 ft	70	77.5
Gravel, sandy; very fine sand to very coarse gravel	77.5	85
Silt, moderately clayey, slightly sandy, yellowish-red and reddish-brown	85	89
Sand, very fine to medium, moderately silty	89	90
Sand, slightly gravelly; very fine sand to fine gravel, much very fine to medium sand	90	102
Gravel, sandy; very fine sand to very coarse gravel	102	123.5
Silt, slightly clayey, brown	123.5	126.5
Gravel, sandy; fine sand to medium gravel	126.5	139.8
Silt, moderately clayey, brown	139.8	140.2
Gravel, sandy; fine sand to very coarse gravel	140.2	159.8
Silty sand to sandy silt, slightly clayey, brown; sand is very fine to medium; less medium sand below 172 ft	159.8	185
Sand, very fine to coarse, few rootlets	185	194.5
Silt, slightly clayey, slightly sandy, brown and reddish-brown; sand is very fine to fine; some fine sand to fine gravel from 224.4 to 225.2 ft; sand is very fine to coarse below 225.2 ft	194.5	232.8
Sand, very fine to fine, moderately silty	232.8	234
Sand, gravelly; very fine sand to medium gravel	234	240
Gravel, sandy; very fine sand to coarse gravel	240	244.4
Silt, very sandy, slightly clayey, reddish-brown; sand is very fine to fine	244.4	246.8
Gravel, sandy; very fine sand to very coarse gravel	246.8	271.5
Silt, moderately sandy, slightly clayey, brown; sand is very fine to medium to 290 ft; some interbedded sand and gravel lenses below 290 ft	271.5	315

	Depth, in Feet	
	From	To
17N-57W-33ccc--continued		
Tertiary-Pliocene-Ogallala--continued		
Sand, gravelly; fine sand to medium gravel; lime-cemented below 330 ft	315	335
Silt, slightly clayey, sandy, gravelly, brown and pinkish-gray; very fine sand to fine gravel, some medium to coarse gravel; some marly areas	335	381
Silt, slightly clayey, sandy, pinkish-white; sand is very fine to medium; marly areas	381	383
Silty sand to sandy silt, slightly clayey, pinkish-gray; sand is very fine to medium	383	447.2
Tertiary System:		
Miocene Series ?		
(Arikaree Group ?)- Undifferentiated		
Silty sand to sandy silt, slightly clayey, brown, some pink; sand is very fine to fine; interbedded marly areas	447.2	538.7
Silty sand to sandy silt, slightly clayey, light brownish-gray, light-gray and brown; sand is very fine to fine; some marly areas	538.7	575
Silty sand to sandy silt, slightly clayey, light reddish-yellow, light-brown, some pink; sand is very fine to fine; some marly areas	575	596.8
Silty sand to sandy silt, slightly clayey, light yellowish-brown, pinkish-gray, light brown and grayish-brown; sand is very fine to fine; some marly areas	596.8	638
Tertiary System:		
Oligocene Series (White River Group)-undifferentiated		
Silt, slightly clayey, pale-brown, slightly calcareous	638	645.3
Silt, very clayey, pale-green to greenish-gray, slightly calcareous	645.3	654
Silt, very clayey, bluish-gray, moderately calcareous	654	667.5
Silt, moderately clayey, pale-blue, moderately calcareous	667.5	671
Silt, moderately clayey, bluish-gray, slightly calcareous	671	690.5

PLATE 6


BANNER COUNTY
R. 59 W.
R. 58 W.
R. 57 W.
R. 56 W.
R. 55 W.
R. 54 W.
R. 53 W.
T. 16 N.
T. 15 N.
5050
4852
4817
4709
4618
4509
4392
4961
Unable to Measure
4740
4677
4544
4457
4761
4687
4582
4447
4369
5121
Unable to Measure
4616
4503
4416
Bennett Reservoir
5100
5000
4700
4600
4500
4400



C O L O R A D O

UNIVERSITY OF NEBRASKA
Conservation and Survey Division
V. H. Dreeszen, Director

0 1 2 3 4 5 MILES
SCALE

Prepared by F. A. Smith
Drafted by B. Pease

CONFIGURATION OF WATER TABLE
KIMBALL COUNTY, NEBRASKA
1971

EXPLANATION

●4919
Test hole drilled by the Conservation and Survey Division in cooperation with the U. S. Geological Survey in 1969

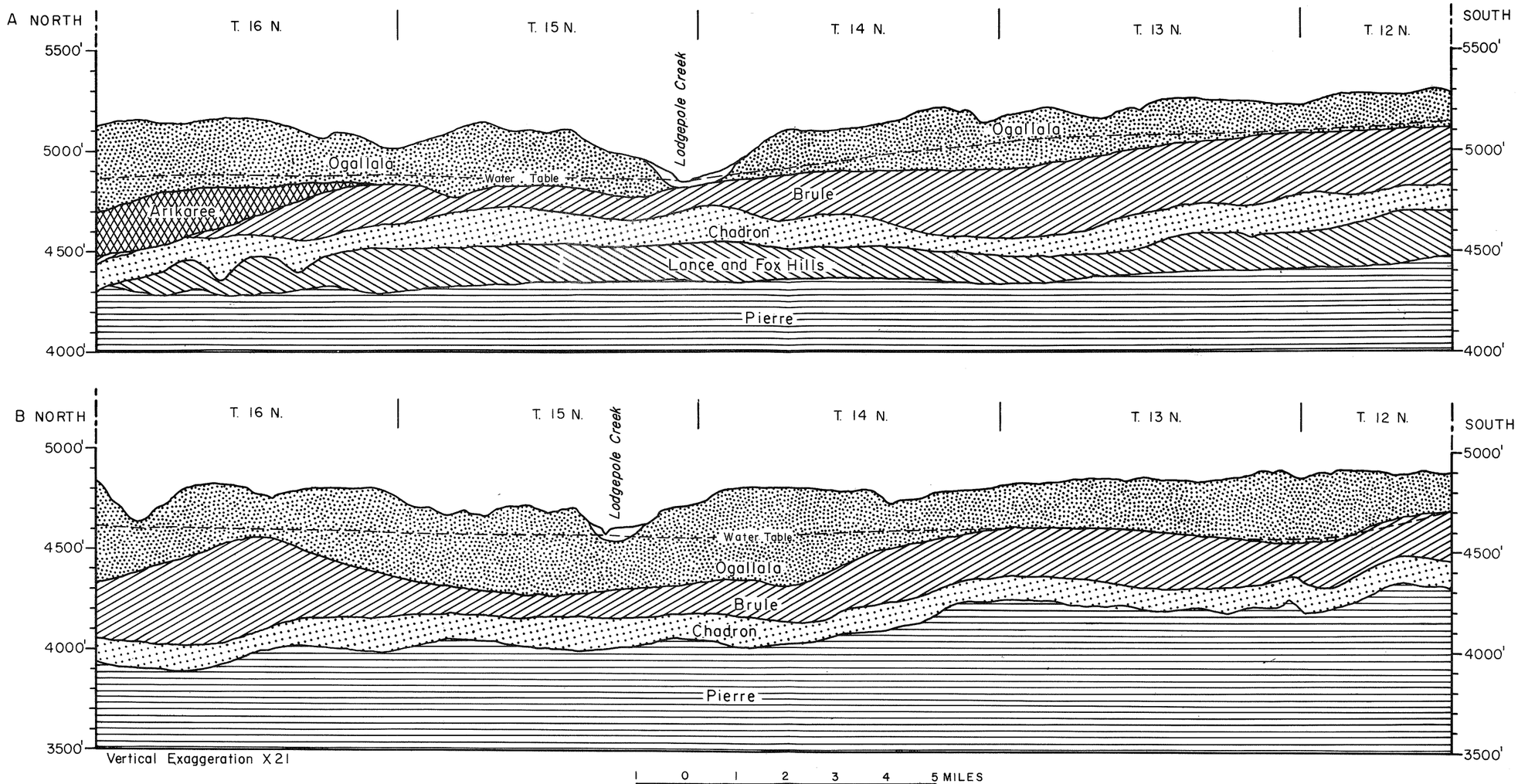
◉4510
Test hole drilled for the American National Bank in 1970

4800
Contour line on the water table

Contour interval 50 feet
Datum is mean sea level

Numbers indicate altitude of water table in feet above mean sea level

PLATE I

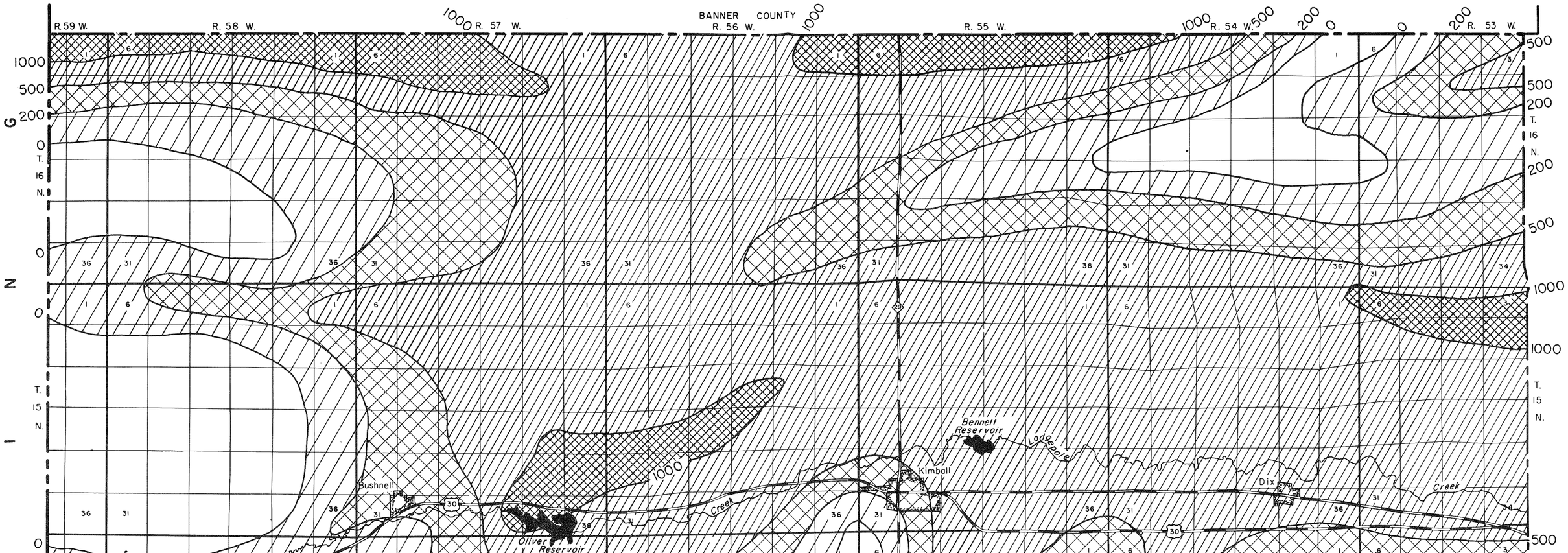


EXPLANATION

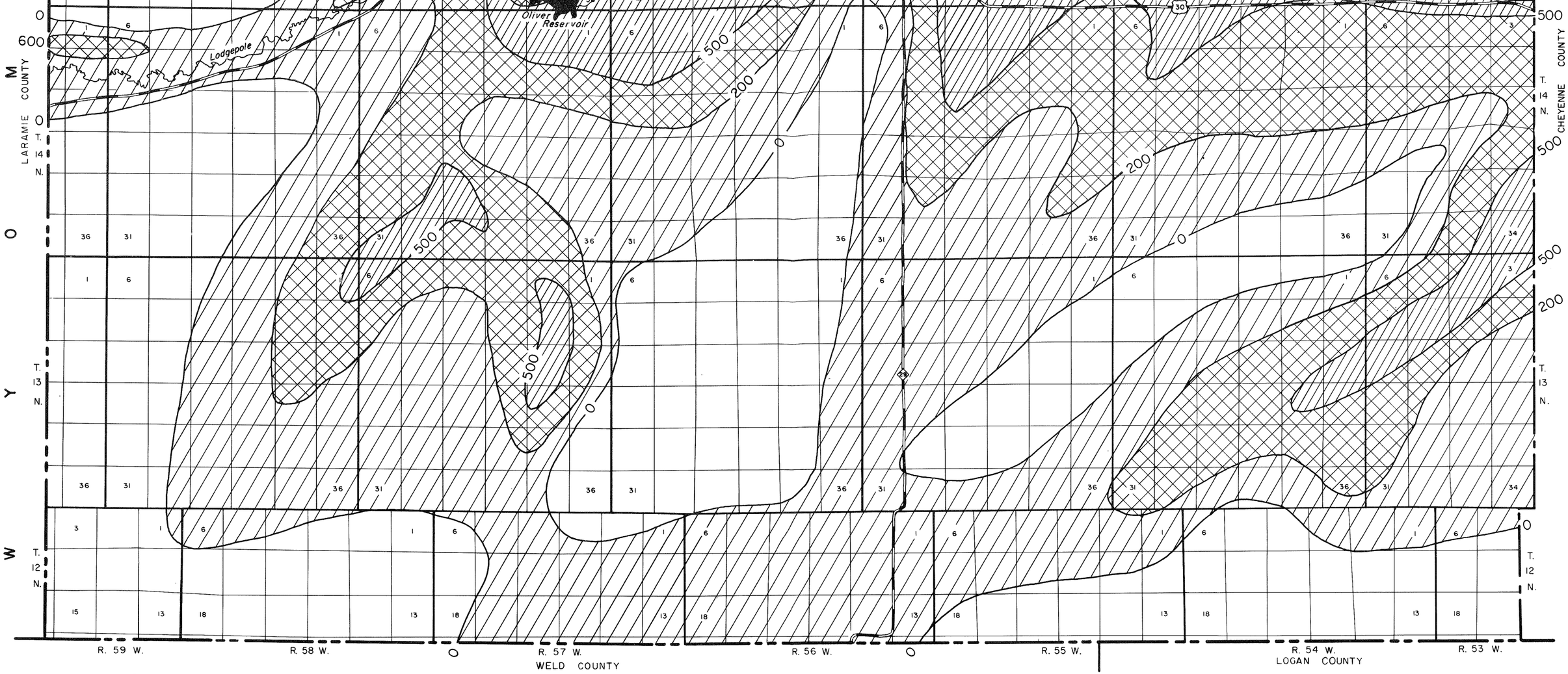
- Pleistocene valley fill (beds of silt, clay, sand, and gravel)
- Ogallala Formation (beds of silt, clay, sandy silt, silty sand, sand, sandstone, limestone, and gravel)
- Arikaree Group of formations (beds of sandy silt, silty sand, sand)
- Brule Formation (beds of clayey silt, siltstone, and sandy silt)
- Chadron Formation (beds of clay and silt; locally contains some thin beds of sandstone)
- Lance and Fox Hills Formations (beds of sandstone, silt and shale)
- Pierre Formation (beds of silt, sandy silt, and clay shale)

GEOLOGIC SECTIONS, KIMBALL COUNTY, NEBRASKA

PLATE 4


BANNER COUNTY
R. 59 W.
R. 58 W.
R. 57 W.
R. 56 W.
R. 55 W.
R. 54 W.
R. 53 W.
T. 16 N.
T. 15 N.
Bushnell
Oliver Reservoir
Kimball
Bennett Reservoir
Lodgepole
Dix
Creek
N

POTENTIAL YIELDS FROM WELLS
KIMBALL COUNTY, NEBRASKA
1971



C O L O R A D O

UNIVERSITY OF NEBRASKA
Conservation and Survey Division
V. H. Dreeszen, Director

0 1 2 3 4 5 MILES
SCALE

Prepared by F. A. Smith
Drafted by Bryce Pease

EXPLANATION

Potential for large yields (1000 gallons per minute or more)

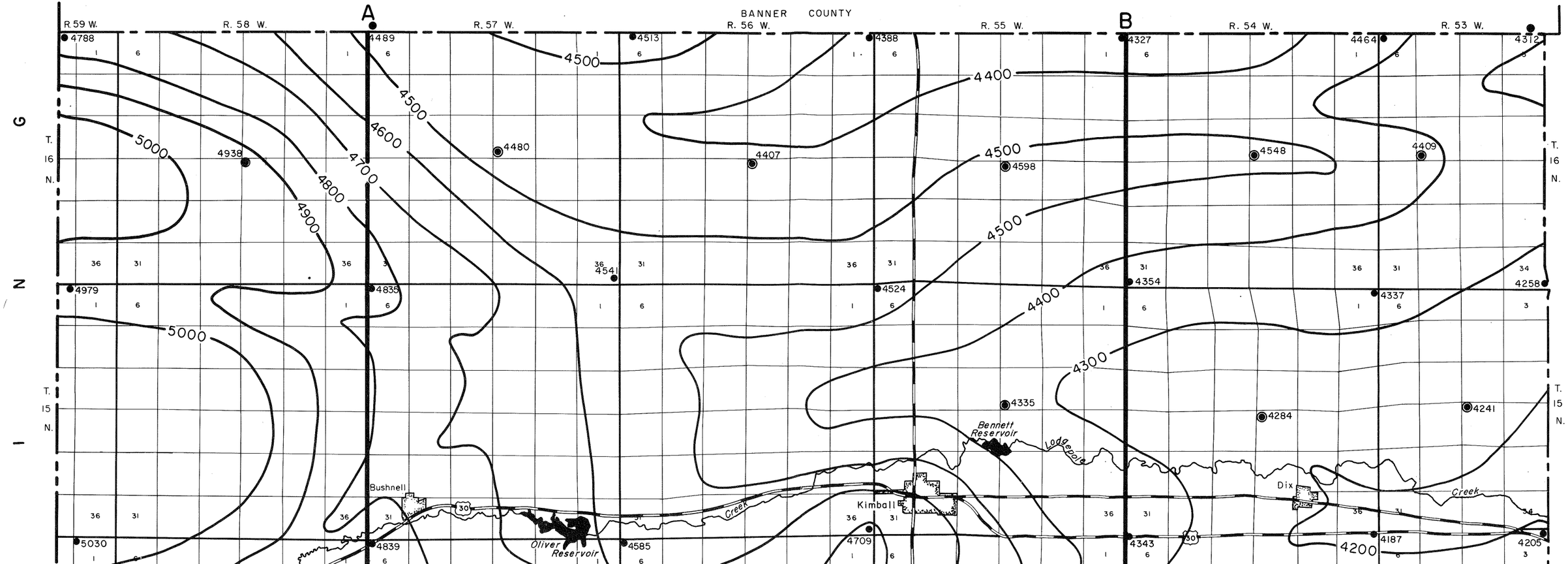
Potential for small to moderate yields (200–500 gallons per minute)

Potential for little or no yield

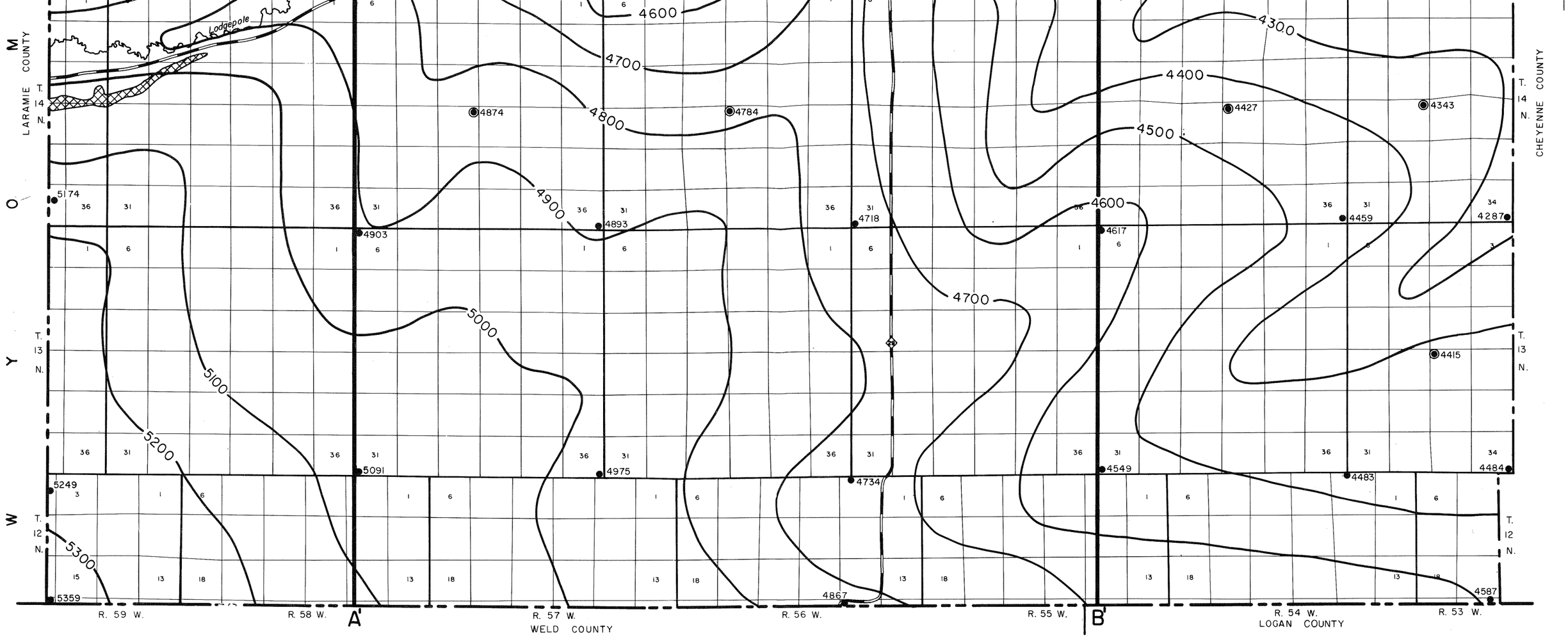
Potential for moderate to large yields (500 to 1000 gallons per minute)

Potential for small yields Less than 200 gallons per minute)

PLATE 2


BANNER COUNTY
A
B
R. 59 W.
R. 58 W.
R. 57 W.
R. 56 W.
R. 55 W.
R. 54 W.
R. 53 W.
T. 16 N.
T. 15 N.
4788
4489
4513
4388
4327
4464
4312
4938
4480
4407
4598
4548
4409
4979
4835
4541
4524
4354
4337
4258
4335
4284
4241
5030
4839
4585
4709
4343
4187
4205
4500
4400
4600
4700
4800
4900
5000
4300
4200
Bushnell
Kimball
Dix
Bennett Reservoir
Oliver Reservoir
Lodgepole
Creek
30
N

CONFIGURATION OF TOP OF BRULE (OR OLDER) FORMATION
KIMBALL COUNTY, NEBRASKA
1971



COLORADO

UNIVERSITY OF NEBRASKA
Conservation and Survey Division
V.H. Dreeszen, Director

Prepared by F.A. Smith
Drafted by P.L. Poyner

EXPLANATION

●4893
Test hole drilled by the Conservation and Survey Division in cooperation with the U.S. Geological Survey in 1969

◉4335
Test hole drilled for American National Bank in 1970

Numbers indicate the altitude of the top of the Brule or older formation in feet above mean sea level

4700
Contour line at top of Brule or older formation
Contour interval 100 feet
Datum is mean sea level

Brule Formation outcrop

A
A'
Line showing location of geologic section